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# **THE REVIEW OF APPLIED ENTOMOLOGY.**

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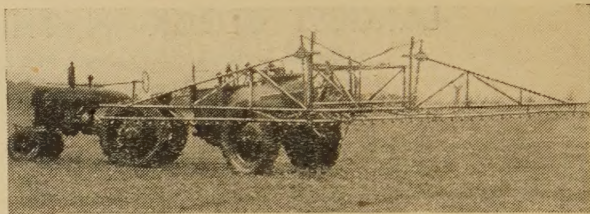
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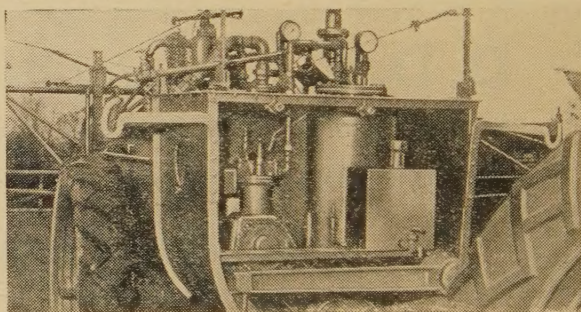
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FAWCETT (G. L.). **Departamento de Botánica y Fitopatología.** [Department of Botany and Phytopathology (Report for 1943 of the Tucumán Experiment Station).]—*Rev. industr. agric. Tucumán* **34** no. 7-12 pp. 149-150. Tucumán, 1944.

It is stated in the course of this report on work in Tucumán in 1943 that *Frankliniella paucispinosa*, Moul., which transmits the virus that causes corcova disease of tobacco [cf. *R.A.E.*, A **26** 581 ; **29** 608] and is constantly present on the flowers of solanaceous plants, also occurs on the flowers of certain weeds, *Medicago* spp., including lucerne, and *Melilotus alba*. To discover whether the virus occurs, though in an inapparent condition, in these plants, thrips from them were caged over healthy tobacco, but without result. As, however, the thrips can spread from them to tobacco, it should not be grown near lucerne, and weeds should be removed from roadsides and ditches in the neighbourhood.

The spraying of seed-beds [cf. **26** 581] is stated to be useless, as *F. paucispinosa* does not occur in them. When a spray of 2 lb. Paris green and 75 lb. sugar per 100 gals. water was applied weekly to tobacco plants, 33 per cent. of these became infected by the disease, as compared with 50 per cent. of untreated plants. No immune variety of tobacco has been found.

HAYWARD (K. J.). **Departamento de Entomología.** [Department of Entomology (Report for 1943 of the Tucumán Experiment Station).]—*Rev. industr. agric. Tucumán* **34** no. 7-12 pp. 151-165. Tucumán, 1944.

Rice was attacked in 1943 by two pests not previously recorded on it in Tucumán, *Diatraea saccharalis*, F., and the Pentatomid, *Tibraca limbativentris*, Stål, which injured the newly formed ears. Sugar-cane in Santa Ana was severely attacked in January by larvae of the Noctuids, *Mocis repanda*, F., *Anticarsia irrorata*, F., and *Laphygma frugiperda*, S. & A. *Coccus* (*Lecanium*) *deltae*, Lizer, continued to be the most serious pest of *Citrus* [cf. *R.A.E.*, A **33** 4] and was still extending its range ; *Unaspis citri*, Comst. [cf. **33** 132] was also abundant in some places, and there were several minor outbreaks of *Icerya purchasi*, Mask., but the latter were soon controlled by *Rodolia cardinalis*, Muls., of which ten colonies were distributed. The rust mite, *Phyllocoptruta oleivorus*, Ashm., injured 90-95 per cent. of the fruits of *Citrus* in some orchards, but was easily controlled by sulphur sprays and dusts. Fruit-flies [cf. **33** 134] were fairly injurious to soft-fruits and to apples ; cages containing parasitised material [cf. **34** 291] were again distributed against them, the parasite concerned in most cases being *Eucoila pelleranoi*, Brèth., which was by far the commonest species reared from *Anastrepha fraterculus*, Wied., in March-May 1942.

Coccids on plants of economic importance other than *Citrus* included *Coccus* (*Lecanium*) *hesperidum*, L., *Pseudaulacaspis pentagona*, Targ., and *Hemiberlesia rapax*, Comst., on mulberry, *Saissetia oleae*, Bern., on fig, *S. nigra*, Nietn., on cherimoya [*Annona cherimolia*], *Hemiberlesia lataniae*, Sign., *Chrysomphalus dictyospermi*, Morg., and *Saissetia coffeae*, Wlk. (*hemisphaerica*, Targ.), on avocado and the last two also on tea, *Coccomytilus lantanae*, Green & Laing, on castor (*Ricinus communis*), and *Quadraspidiotus perniciosus*, Comst., on almond. In Santa Ana, avocado trees were attacked by *Platyphus sulcatus*, Chapuis, and cotton by *Alabama argillacea*, Hb., of which the commonest parasites were Sarcophagids and *Brachymeria ovata*, Say. Cotton in unweeded fields was infested in January by *Loxostege bifidalis*, F., but it caused only slight damage and was soon overcome by natural enemies. Eight species of parasitic Hymenoptera were reared from the larvae, most of them still unidentified.

The most serious pest of garden crops was *Phyrdenus muriceus*, Germ., which destroyed large areas of tomato seedlings in some districts and also attacked *Capsicum*. Larvae of *Cocytius cluentius*, Cram., *Plusia egena*, Gn., and *Thyreion gelotopoeon*, Dyar, were found on sweet potato, *Mentha spicata* and chick-peas [*Cicer arietinum*], respectively, these being new foodplants for them. Larvae of *Ligyrys burmeisteri*, Steinheil, damaged the roots of sunflower, and those of *T. gelotopoeon* the seeds. Cutworms (*Agrotis ypsilon*, Hfn.) caused considerable injury to potato in the hills in the south and central parts of the Province. *Gnorimoschema operculella*, Zell., was observed on potato in many places, but caused little damage, probably owing to control by natural enemies. The chief pests of tobacco continued to be *Protoparce sexta paphus*, Cram., and *Heliothis virescens distincta*, Schaus. Cotton-seed meal was attacked by *Tribolium confusum*, Duv., and stored cotton-seed by the larvae of *Myelois* sp., probably *M. ceratoniae*, Zell.

Parasites reared during the year included *Signiphora merceti*, Malen., from *Coccomytilus lantanae*; *S. xanthographa*, Blanch., *Cales noacki*, How., *Eretmocerus paulistus*, Hemp., and a species of *Encarsia* from *Aleurothrixus howardi*, Quaint.; *Spilochalcis magistretti*, Blanch., from *Oiketicus geyeri*, Berg; and *Microplitis ayerzai*, Brèth., from *Protoparce sexta paphus*.

Insects recorded from other Provinces include *Pseudischnaspis bowreyi*, Ckll., on olive in La Rioja, *Parlatoria oleae*, Colv., on *Citrus* in Jujuý, *Chrysomphalus ficus*, Ashm., on *Citrus*, avocado and mango, *C. dictyospermi* on *Citrus* and mango, *Hemiberlesia rapax* on mango, and *Pulvinaria* (*Protapulvinaria*) *pyriformis*, Ckll., on avocado in Jujuý and Salta, and the Tenebrionid, *Épitrágus similis*, Steinheil, predacious on both *Aonidiella aurantii*, Mask., and *Unaspis citri* in Entre Rios.

HOLDAWAY (F. G.) & others. **Entomological Problems.**—Rep. Hawaii agric. Exp. Sta. 1942-44 pp. 59-76, 7 figs., 14 refs. Honolulu, 1945.

This report deals with work on insect pests in Hawaii, some of which has already been noticed [R.A.E., A 33 217; 34 274-276; 35 6], during the two years ending 30th June 1944. Particular attention was devoted to pests of vegetables. The chief pests of tomato are *Heliothis armigera*, Hb., which is the most injurious and has become more abundant and widespread owing to increased cultivation of maize, *Dacus cucurbitae*, Coq., *Engytatus geniculatus*, Reut. (*Cyrtopeltis varians*, Dist.), and *Vasates* (*Phyllocoptes*) *destructor*, Keifer [33 250]. During the spring of 1944, *Macrosiphum solanifolii*, Ashm., which becomes abundant on tomato and potato during the cool, moist weather in winter, was the most important pest of tomato in some parts of Oahu. The larvae of a Cecidomyiid tentatively identified as *Contarinia lycopersici*, Felt, have been found feeding in the flower buds of tomato, egg-plant [*Solanum melongena*] and pepper [*Capsicum*] on Oahu, causing the flowers to fall. Infestation is most frequent during spring and early summer at low elevations, and up to 48 per cent. of the flowers on one variety of tomato have been infested. *Aphis ferruginea-striata*, Essig [27 590] was collected on carrot and dill [*Peucedanum graveolens*] in and near Honolulu; it caused no serious injury, but was numerous on individual carrot plants. *Frankliniella sulphurea*, Schmutz, which was not known in the Hawaiian Islands until August 1942, when it was found infesting the flowers of lima beans, has been collected from the flowers of over 25 plants on Oahu, Hawaii, Maui, Molokai and Kauai, as well as on the leaves of crop plants, and has become the commonest flower thrips in the drier areas. Species of *Nysius*, of which *N. nigriscutellatus*, Usinger, and *N. nemorivagus*, White, are the commonest, were abundant on market garden crops. They caused the leaves of garden beet, *Capsicum* and Chinese spinach [*Amarantus*] to wilt and those of maize to dry up on Oahu, and severely damaged celery plants and seedlings on

Hawaii. Injury to cucumber, tomato and egg-plant, generally young plants in hot, dry places, is caused by *Solenopsis geminata rufa*, Jerd., which attacks the stems at and below ground level, as a result of which the plants wilt and die, and also the terminal shoots of egg-plant.

Tests of carriers for nicotine added to cryolite dusts against vegetable pests were made because mixtures of cryolite and lime, the common carrier for commercial nicotine dusts, have been found to cause serious injury to tomato and *Capsicum* if applied while the plants are wet. In tests of dusts containing 3 per cent. actual nicotine against *Pycnoderes quadrimaculatus*, Guér., on lima beans, to which cryolite is commonly applied against the bean pod borer [*Maruca testulalis*, Geyer], nicotine sulphate in talc, gypsum, lime and volcanic ash (Friarite) gave 100, 99.5, 99 and 98.5 per cent. control, respectively, and free nicotine in Friarite also gave 98.5 per cent. The gypsum dust was too moist for satisfactory application with a rotary duster. In tests of dusts containing 4 per cent. nicotine against *Engytatus geniculatus* on tomato, nicotine sulphate in talc was more effective than free nicotine in talc or Friarite, and resulted in more fruits and less injury to the plants. When 3 per cent. nicotine in various forms was added to a dust of 50 per cent. cryolite in talc applied to cabbage, it gave increased control of *Hellula undalis*, F., and marked control of Aphids, and increased the yield. Infestation by Aphids was greater on cabbages treated with the mixture of cryolite and talc alone than on untreated ones. In further tests against this Pyralid, initial infestation was slightly lower on plants treated with lead arsenate and talc (1 : 1) and slightly higher on those treated with DDT in talc (1 : 100) than on those treated with the nicotine-cryolite mixtures, but little or no injury due to the larvae was found at harvest in the plots treated with any of these dusts.

Following the discovery that the sweet-potato leaf miner, *Bedellia orchilella*, Wlsm., can be almost completely controlled by two applications of a spray containing 2 lb. Paris green per 100 U.S. gals., experiments were made to compare the effects of sprays of nicotine, rotenone, and nicotine and Paris green, all in diesel-oil emulsion [cf. 32 136], and of lead arsenate. A single application of the nicotine spray gave 75 per cent. control of the unexposed and partly exposed larvae and one of the rotenone spray gave 59 per cent. The percentages by which the number of new leaf-mines were reduced 12 days after application were 80 and 73 for nicotine with and without Paris green, 63 for rotenone and 60 for lead arsenate (4 lb. per 100 U.S. gals.). Spray injury was severe on all plots treated with Paris green. It is concluded that lead arsenate at the concentration tested shows promise for use against this Tineid, though immersing the cuttings at planting time in a dip of Paris green (2 lb. Paris green per 100 U.S. gals.) and later spraying twice with the same insecticide at the same concentration gives promise of still better protection.

The attempt to establish *Encarsia formosa*, Gah., on Oahu for the control of *Trialeurodes vaporariorum*, Westw., on green beans [cf. 32 138] having proved unsuccessful, methods of chemical control were investigated. After preliminary tests indicating that dilute emulsions of refined oil could safely be used on the beans, good results were given by DDT in work that has already been noticed [34 275].

As plants treated with bait-sprays containing tartar emetic against *Dacus cucurbitae* are likely also to be treated with fungicides and other insecticides, the effect of mixing common fungicides with the bait-spray was tested. All reduced its toxicity, though the reduction was less with copper oxide than with other copper compounds. A mixture of basic copper arsenate and nicotine sulphate was almost as toxic to *Dacus* as tartar emetic and would also control other insects. DDT was infective against it in baits, and DDT dusts lost their high initial toxicity [34 276] in a short time when the cages treated with them were exposed to outdoor conditions and frequent light rains. A spray containing 2 lb. DDT per 100 U.S. gals. was as effective as a 2 per cent. dust and

retained its effectiveness longer. The use of systematically sprayed barrier crops showed promise.

In experiments with fumigants for the control of *Dermestes ater*, Deg. (*cadaverinus*, F.) and *D. maculatus*, Deg. (*vulpinus*, F.) in rabbit skins to be shipped to the United States [cf. 34 274], paradichlorobenzene gave the best control for the first month, but a large population of larvae developed during the second. Flake and crude naphthalene gave lower initial control, but remained effective for longer, owing to their slow rate of evaporation; the flake naphthalene appeared to be slightly the more effective. Camphor gave relatively poor control. Of materials other than fumigants, DDT and, to a lesser degree, boric acid, showed promise of control over an extended period.

GIVEN (B. B.). **Tachinid Parasites attacking Melolonthid Larvae in New Zealand.**—*Trans. roy. Soc. N.Z.* 75 pt. 3 pp. 321–323, 2 pls., 4 refs. Wellington, N.Z., 1945.

In the course of surveys made in parts of the Nelson province of New Zealand during the summer of 1943–44, numerous Melolonthid larvae were found parasitised by Tachinids. None of the parasites was observed to attack *Odontria zealandica*, White, and none of the parasitised material was collected in open pasture, most of it being from the bush-line or dense forest. Parasitism was greatest at a height of over 4,000 ft. in the Upper Travers Valley, where the species most commonly parasitised was *Pyronota inconstans*, Brookes, and the parasite concerned was *Avibrissina brevipalpis*, Mall. This Tachinid also heavily parasitised larvae of *Pyronota* sp. on the Whangamoia Saddle. *Neotachina laticornis*, Mall., parasitised undetermined species of *Odontria* in these districts and the Upper Matai Valley, and was attacked by a Proctotrupoid hyperparasite in the first of them. Three larvae of *Prociissio cana*, Hutton, were found in a larva of *Chlorochiton* sp. The full-grown larvae of the three Tachinids are described and figured.

HALL (W. J.). **An apparently new *Margarodes* (Coccoidea) injurious to Grass Lawns in the northern Sudan.**—*Proc. R. ent. Soc. Lond.* (B) 14 pt. 11–12 pp. 136–140, 17 figs. London, 1945.

The author describes the first-stage, second-stage and adult females of *Margarodes aureliana*, sp. n., a Coccid that was found on the roots of *Cynodon dactylon* at Atbara in the Sudan, in 1939 and 1945, and was said to cause serious damage to grass lawns there. Characters distinguishing it from related species are given.

RAHMAN (K. A.), GURCHAR[A]N SINGH SOHI & AMAR NATH SAPRA. **Studies on stored Grain Pests in the Punjab. VI. Biology of *Trogoderma granarium* Events.**—*Indian J. agric. Sci.* 15 pt. 2 pp. 85–92, 1 fig., 14 refs. Delhi, 1945.

*Trogoderma granarium*, Everts, infests stored wheat throughout northern India and is a serious pest in the plains of the Punjab, especially the hotter and drier parts. A study of its biology in the laboratory and in storehouses at Layallpur, was carried out in 1939–43. The adults were observed to mate immediately upon emergence, and the preoviposition and oviposition periods lasted 1–5 and 1–8 days. The number of eggs laid per female was greatest in April and May and least in October, the maximum being 89 and the average ranging from 15.9 to 52.7. The eggs hatched in 3–10 days, according to season,

and the percentage that hatched ranged from 41.5 in June to 86.8 in September. The larval and pupal stages lasted 16–53 and 3–6 days for males and 20–63 and 3–8 days for females, the male larvae having 3–4 instars and the females 4–6. The adults rested for 15–78 hours before emerging from the last larval skin, in which pupation occurs, and survived for about 5–11 days. It was found that there were 4–5 overlapping generations a year. The overwintered larvae resumed activity in late March or early April and pupated and gave rise to adults later in April. All stages were present and damage at a maximum from May to August; some of the larvae that hatched in the laboratory in early August and all those that did so after 15th August hibernated. The last eggs were laid at the end of October in the laboratory and a month later in heavily infested storehouses in which insect activity raises the temperature of the grain. Hibernation did not begin in storehouses until the end of November.

Studies with 26 larvae on each food showed that the duration of development was somewhat shorter on wheat, maize, bajra (*Pennisetum typhoideum*), sorghum and rice than on barley and somewhat longer on gram (*Cicer arietinum*) walnut and pista (*Pistacia vera*). The percentage of larvae surviving was greatest on rice and much lower on sorghum than on any other food. Female larvae consumed about twice as much food as males.

Observations on heaps of wheat showed that infestation is severe down to a depth of 30 ins. and is almost negligible at 6 ft., though it may occur as deep as 9 ft. along walls and in corners. In a single storing season, the average percentage of wheat grains damaged by *T. granarium* in seedsmen's stores was 5.9–32.8, while the average loss of weight caused by it in wheat in grain merchants' stores was between 2.25 and 5.47 per cent.

WILSON (G. F.). **D.D.T. : Investigations on its Effect upon some horticultural Pests.**—*J. R. hort. Soc.* **71** pt. 1 pp. 6–13. London, 1946.

A table is given showing the results of tests in southern England in 1944–45 in which a dust containing 5 per cent. DDT and proprietary emulsions diluted to contain 1 and 0.1 per cent. DDT were applied against various pests. The 0.1 per cent. spray was effective against immature Coccids, larvae of Lepidoptera and sawflies, beetles, a thrips, immature Tingids, a Jassid and the Aleurodid, *Trialeurodes vaporariorum*, Westw., but even the 1 per cent. spray had little effect on Aphids and none on *Tetranychus telarius*, L. The sprays were also toxic to predacious Coccinellids and to adults of *Encarsia formosa*, Gah., the parasite of *T. vaporariorum*. The dust was effective against Lepidopterous larvae, flea-beetles, weevils and two species of woodlice. Since these experiments were carried out, improved formulae that give increased toxicity to a wider range of pests and that are not injurious to plants have been devised.

BOVEY (P.). **La lutte contre l'anthronome d'hiver du poirier** (*Anthonomus pyri* Kollar=*A. cinctus* Redt.).—*Rev. hort. Suisse* 1943 repr. 10 pp., 7 figs., 4 refs. Geneva, 1943.

*Anthonomus pyri*, Koll., which first became injurious to pear in Switzerland about 1930 [*cf.* *R.A.E.*, **A** **24** 133], subsequently spread considerably in the Rhone Valley and by 1940 was regularly infesting almost all the fruit buds in some pear orchards in the canton of Valais. The author reviews its bionomics from the literature [*cf.* **24** 133; **26** 761; **27** 632] and states that he has reared the Ichneumonid, *Ephialtes* (*Pimpla*) *pomorum*, Ratz., and the Pteromalid, *Habrocytus fasciatus*, Thoms., from larvae in buds. The recommended method of control is to spray with a proprietary preparation of pyrethrum and soap in autumn before the females have oviposited [*cf.* **29** 617], and experiments

begun in 1941 showed that both this material at lower concentrations than that hitherto used and sprays of DDT (Gesarol) are effective for this purpose. It is concluded that the best results are given by a heavy application between 15th and 20th September. Severely infested orchards should be treated for two consecutive years, but treatment every two or three years should suffice if infestation is light.

BOVEY (P.) & MARTIN (Henri). **Les traitements d'hiver des arbres fruitiers et la lutte contre l'Anthonome du pommier.**—*Rev. hort. Suisse* 1944 no. 3 repr. 8 pp., 7 figs., 5 refs. Geneva, 1944.

Prior to 1940, proprietary preparations containing tar distillates and a soap emulsifier, known as "normal carbolineums", which were applied at a concentration of 4 per cent., were in general use as winter washes against pests of fruit trees in Switzerland, but when the ingredients of the emulsifier became scarce owing to war conditions, preparations in which the tar distillate was already emulsified in a small amount of water by a process that did not involve the use of soap [cf. *R.A.E.*, A 31 324] were substituted; these so-called "emulsified carbolineums" were applied at 6 per cent. and were compatible with Bordeaux mixture and lime-sulphur. In 1943, tar distillates were no longer readily available and were largely replaced by preparations of an alkaline salt of dinitro-o-cresol, subsequently referred to as DN sprays, which are about as effective as tar distillates and can safely be used on all fruit trees, including peach and apricot, to which the normal carbolineums were injurious. The results of comparative tests with carbolineums, DN sprays and a spray of DDT (1 per cent. Gesarol) made in various orchards in Switzerland in 1943 are given. Earlier work by Wiesmann [cf. 31 377] showed that tar distillates give the best control of the eggs of *Operophtera* (*Cheimatobia*) *brumata*, L., and Aphids when applied at the end of February or the beginning of March, and DN sprays are also best applied at this time. In an apple orchard that had not been sprayed in 1942, trees sprayed with normal carbolineum or a DN spray on 2nd or 22nd March flowered well and yielded a normal harvest, whereas over 90 per cent. of the flowers on the controls were destroyed by *Argyresthia conjugella*, Zell., *Chloroclystis rectangulata*, L., and Tortricids, and the yield was seriously reduced. The late application of carbolineum was almost as effective as the earlier one. DN sprays applied on 8th March against eggs of *O. brumata* on cherry were almost as effective as normal carbolineum, and were equal or superior to normal or emulsified carbolineums against eggs of *Argyresthia ephippella*, F., on cherry. They are as effective as the carbolineums against the eggs of Aphids, but less so against those of *Psylla mali*, Schm., on apple.

DN sprays applied when the buds begin to swell are of value against the overwintered adults of *Anthonomus pomorum*, L. [cf. 31 436] and considerably reduce and in some cases eliminate losses due to this weevil, but DDT is still more effective for this purpose and if applied to coincide with the resumption of activity by the overwintered adults will destroy the females that come into contact with the deposit on twigs and branches before they have oviposited. The latest date for application is when the tips of the foliage leaves appearing above the bud scales begin to separate, but in an experiment in which the spray was applied to apple trees on 19th March, when the buds were only just beginning to swell, the results were almost as satisfactory as those from later applications, and the yield was almost five times that from untreated trees. The addition of copper fungicides or lime-sulphur had no deleterious effect on DDT sprays; in this series of experiments, DN sprays applied as late as 30th March gave about 75 per cent. reduction in the number of capped blossoms, whereas emulsified carbolineum applied on the same date had no effect. When a DDT spray was applied on 22nd March, just before the buds opened, to apple

trees in an orchard that had received no other treatment, it reduced infestation by Lepidopterous larvae, the most important pests present, by 72 per cent., and similar results were obtained in other orchards; it may therefore be possible to replace the usual winter spray treatment against the latter by a late application of DDT, which would also control the weevil.

BENDER (E.). **Untersuchungen zur Biologie und Morphologie der in Weinkellern lebenden Kleinschmetterlinge.** [Investigations on the Biology and Morphology of the Microlepidoptera that inhabit Wine-cellar.]—*Z. angew. Ent.* **27** pt. 4 pp. 541–584, 34 figs., 21 refs. Berlin, 1941.

An account is given of investigations carried out between 1936 and 1938 on the Tineids that damage casks and the corks of bottles in which wine is stored in the Rhineland. The premises investigated comprised cellars beneath buildings [cf. *R.A.E.*, A **12** 292], rock cellars and storerooms, and 59 of 108 of them were found to be infested. The moths concerned, in order of decreasing abundance, were *Dryadaula pactolia*, Meyr., which has not previously been recorded from continental Europe, *Oinophila v-flavum*, Haw., *Tinea cloacella*, Haw., and *T. granella*, L. A few adults, but no eggs, of *Endrosis lactella*, Schiff., and one female of *Hofmannophila pseudospretella*, Staint., were also found. Cellars under buildings, which contained mostly casked wines, had winter and summer temperatures of 6–7°C. [42·8–44·6°F.] and 16–18°C. [60·8–64·4°F.], while cellars hewn out of rock had an average yearly temperature of 8–11°C. [46·4–51·8°F.], varying only by 2–3°C. [3·6–5·4°F.]; the relative humidity in both was 90–98 per cent. Bottle storage rooms under buildings or on ground level had temperatures varying between 4 and 24°C. [39·2–75·2°F.], with less than 90 per cent. relative humidity. Newly constructed cellars that were kept clean were free from fungi and insects.

Larvae and adults of *D. pactolia* were present throughout the year in cellars in which the relative humidity was above 90 per cent., but the adults were most abundant between April and mid-June. The larvae were found on corks and damp sites on casks, and were particularly numerous between the staves and heads of casks. *O. v-flavum* occurred in damp cellars as well as in those in which the relative humidity was only 79 per cent. There was only one generation a year, and the adults were present from mid-June to late September, being commonest in July and August. The larvae tunnelled in corks and in damp wood and emerged to pupate. *T. cloacella* occurred at relative humidities above 93 per cent. The adults were present from early May to late September and most numerous in June. The larvae were found in corks and within the wood in the joints of cask heads, and their feeding caused leakage. They hibernated and pupated in their galleries and there was one generation a year. *T. granella* was found only in bottle cellars; the larvae developed and pupated within the corks, and in some cellars adults were found throughout the year.

The larvae of these moths were never found in the corks of bottles containing spirits. The damage to wine corks caused loss not only by leakage, but also by deterioration of the wine that remained in the bottles. Control measures discussed comprise the use of capsules on bottles and fumigation with hydrocyanic acid gas. An experiment showed that the larvae could be killed by spraying the corks with water several times. The heads of casks placed against the wall should be kept clean.

In the laboratory, females of *D. pactolia* laid averages of 10, 70, 82 and 133 eggs at relative humidities of 25–35, 50–60, 70–80 and over 90 per cent. and temperatures of 20, 20, 17 and 15°C. [68, 68, 62·6 and 59°F.], respectively, and more eggs were laid on wood from casks than on glass. The egg stage lasted 17·5–18 days at 20°C. and about 20 days at 14°C. [57·2°F.] and the larval stage, which comprised 6–8 instars, about 60–84 days at 20°C. and 90–100 per cent. relative humidity in wood from corks. The pupal stage lasted about 19

days at 19°C. [66-2°F.]. Mated and unmated adults lived for 4-9 and 6-11 days, respectively, at 20°C. and 50-60 per cent. relative humidity, the females somewhat longer than the males. Females of *T. granella* and *T. cloacella* oviposited in crevices, preferably in fungi, and laid more eggs at relative humidities above 70 per cent. than at 60 per cent. or less. The egg stage lasted about 9 and 11-12 days, respectively, at about 20°C. Young larvae of *T. granella* placed on the corks of wine-bottles fed on the parts overgrown with fungi and reached full development in 4½-5 months at 13°C. [55-4°F.]. Other experiments in which the larvae of both species were reared on dried fungus or peas showed that the rate of development was accelerated by high humidity and retarded when the larvae were kept singly [cf. 24 812]. The pupal stage in these individuals lasted 16-19 days for *T. granella* and 17-20 days for *T. cloacella*. Adults of both species were reared from eggs laid on unused corks kept at a relative humidity of over 90 per cent., but the larvae died soon after hatching at about 80 per cent.

Pairs of adults of the various species studied and the one female of *H. pseudospretella* were placed on a shark's head that had been preserved in alcohol, and were kept at a relative humidity of 80 per cent. *T. granella* and *E. lactella* bred readily, and some eggs and adults of *H. pseudospretella* were subsequently found, but the other species did not survive.

The adults and larvae of all six moths and the eggs of all except *H. pseudospretella* are described in a final section, with keys to the larvae and adults.

FRANZ (J.). *Der Tannentriebwickler Cacoecia murinana* Hb. *Beiträge zur Bionomie und Oekologie. II. Teil.* [Contributions to the Bionomics and Ecology of the Silver-fir Shoot Tortricid, *Tortrix murinana*. Part II.]—*Z. angew. Ent.* 27 pt. 4 pp. 585-620, 2 figs., 3 graphs, 25 refs. Berlin, 1941.

This second part of a thesis [cf. *R.A.E.*, A 30 207] comprises a detailed account of investigations made in 1939-40 in a forest in Baden on the factors concerned in fluctuations in population of *Tortrix* (*Cacoecia*) *murinana*, Hb., on silver fir (*Abies alba*). Its mortality at each stage of development was studied in the field and by means of samples analysed in the laboratory; the technique employed is described.

Examination in late April and May 1939 of buds of selected fir trees showed that the mortality of larvae in the second and third instars in spring was at least 33.2-43.5 per cent., and since there was little evidence of attack by predators and none of fungous disease, the high mortality was attributed to the low temperatures prevalent throughout the month. From an analysis of the results the author concludes that larvae in the second instar (the first feeding stage) are particularly sensitive to climatic influences. The effect of weather on older larvae was insignificant, since only 1 per cent. of a batch under observation died from causes other than parasitism. Parasitism accounted for 26.4 per cent. mortality of the older larvae and 61.1 per cent. among pupae, so that the total in these stages was 71.4 per cent. The parasites were, in approximate order of decreasing abundance, *Itoplectis* (*Pimpla*) *maculatur*, F., *Apechthis* (*P.*) *rufata*, Gmel., *Glypta murinanae*, Bauer (sp., n.), *Monodontomerus aereus*, Wlk., *Diadromus troglodytes*, Grav., *Apanteles albipennis*, Nees, *Angitia armillata*, Grav., *Ephialtes* (*Pimpla*) *inquisitor*, Scop., and the Tachinid, *Ptychomyia selecta*, Mg. Bauer's description of *Glypta murinanae* [Mitt. ent. Ges. Halle Heft 19 pp. 11-12, 1942] was published after this paper was written, but characters by which he distinguishes the adults from those of *G. incisa*, Grav., are given. The hyperparasites found were *Hemiteles bicolorinus*, Grav., probably on *G. murinanae*, and *H. melanogaster*, Thoms., probably on *Apanteles*. Lists are given of hosts on which many of these parasites have previously been recorded, and also of parasites of *T. murinana* recorded by previous workers [cf. 24 341].

The most important of the parasites reared from the larvae were *G. murinanae* and *Apanteles albipennis*, both of which had oviposited by early May. Larvae of

both left their hosts towards the end of June or in early July and pupated in cocoons, those of *Glypta* being formed either on the ground or on the twigs, and those of *Apanteles* between the needles. The adults of *Glypta* emerged in the second half of July, and those of *Apanteles* in late June and the first half of July. *Angitia* attacked the host larvae early in June, and the adults emerged during the latter half of July. Cocoons of *E. inquisitor* were found towards the end of June attached to a full-grown *Tortrix* larva, and the adults emerged in mid-July. The most abundant of the parasites reared from the pupae was *I. maculator*, which was obtained from about 50 per cent. of the parasitised pupae caged at the end of June. The adults emerged between 9th and 23rd July, a previous generation having possibly developed on *Tortrix viridana*, L., which was fairly abundant on oak during the observations. A few larvae of *Apechthis rufata*, which was also very abundant, emerged from sixth-instar host larvae and spun groups of cocoons between the fir needles, but the majority emerged from pupae between 8th and 26th July. *M. aereus* was obtained from about 25 per cent. of the parasitised pupae, three or four adults emerging from each in July or August. This Torymid was probably a primary parasite [cf. 20 58]. *D. troglodytes*, which had not previously been recorded from this host, attacked the larvae in late May or early June, continued its development in the pupae and gave rise to adults between 14th and 26th July. Larvae of *P. selecta* emerged from two parasitised pupae.

About 6-8 per cent. of older larvae and pupae were destroyed by birds, a list of which is given, and 11.9 per cent. of pupae reared in the field died of disease, apparently bacterial. One unidentified Coccinellid larva was found attacking a prepupa.

Owing to their small numbers, it was not possible accurately to assess the course of mortality of the adults, but it was thought that many were destroyed by birds and possibly by bats. None of 2,053 eggs examined was parasitised, but 3-5 per cent. failed to hatch.

With a view to determining the mortality of first-instar larvae, laboratory tests of their resistance to heat were carried out in the summer of 1939. Newly hatched larvae subjected for six days to temperatures ranging between 22 and 39°C. [71.6 and 102.2°F.] showed the greatest resistance to heat at a relative humidity of about 40 per cent., at which less than 10 per cent. died at 27°C. [80.6°F.], about 50 per cent. at 34°C. [93.2°F.] and all at 36°C. [96.8°F.]. The author concludes from these experiments, and from a review of the literature, that the entry into diapause is connected with a loss of free (evaporable) moisture.

Examination of the amount of damage by *T. murinana* to silver-fir shoots in a forest in Austria in 1938 confirmed that fluctuations in its numbers are greatly influenced by the local climatic conditions prevalent in April and early May, when the second-instar larvae enter the buds; no connection was found between these fluctuations and sunspots [cf. 24 341].

FRIEDERICH (K.), SCHAERFFENBERG (B.) & STURM (H.). **Ueber die Feinde des Kiefernspanners, mit Berücksichtigung des Mischwaldes.** [The Enemies of the Pine Geometrid, with Regard to Mixed Forests.]—*Z. angew. Ent.* 27 pt. 4 pp. 621-641, 2 figs., 35 refs. Berlin, 1941.

Infestation of pines by *Bupalus piniarius*, L., is much less severe in mixed than in unmixed stands, and it has been suggested that this is due to the greater effectiveness of natural enemies in the former [cf. *R.A.E.*, A 30 616]. To test this view, investigations were carried out in Mecklenburg, in the course of work there in 1937-40, during an outbreak. The percentages of parasitised eggs found in July 1939 in mixed and unmixed stands in three forest areas, varied considerably, and in two areas were greater in the unmixed stands, but the average was nearly 20 for both classes. Control by egg parasites is not usually great, and a survey in ten other forest areas in the same years showed that the

percentage of parasitism averaged 8.95, as compared with 52.51, 8.7, 33.45, 19.2 and 17.3 in one area for the five successive years (1930-34) immediately following a previous outbreak [cf. 19 614]. The parasites obtained were *Trichogramma evanescens*, Westw., and *Telenomus* sp., the former being ten times as numerous as the latter. The only other insects that attack the eggs are the predacious adults of *Raphidia* spp.

Natural enemies of the larvae were not studied in stands of the two types separately, but feeding tests were made in which numerous insects, including Coccinellids, Reduviids, Pentatomids, Chrysopids and Syrphids, together with a few spiders and centipedes, were collected from felled pines between late July and early August 1939 and reared in petri dishes with *Bupalus* larvae of all sizes and, in some cases, supplementary food. The results indicated that the most important predators were *Reduvius* spp., the Pentatomids, *Troilus luridus*, F., and *Picromerus bidens*, L., and the Coccinellids, *Anatis ocellata*, L., *Halysia sedecimguttata*, L., and *Coccinella septempunctata*, L., all of which attacked larvae of all sizes. Less important predators were the larvae of *Raphidia* and of *Syrphus tricinctus*, Fall., and earwigs (*Forficula auricularia*, L.). It was evident that the disparity in the numbers of larvae and their predators taken from felled trees during an outbreak was too great for much control to be afforded by the latter.

Since red forest ants (*Formica rufa*, L.) have been held to afford valuable control of forest caterpillars [cf. 33 15, etc.], observations were made on their effectiveness against *B. piniarius*. Of felled pine trees, one next to a medium-sized nest of *F. r. rufo-pratensis*, Forel, was found to be practically free from larvae, but others only about 66 ft. away had over 1,000. The ants were frequently seen carrying not only larvae but also Hymenopterous parasites. In late autumn, the numbers of pupae per sq. m. of soil surface averaged 9.9 and 14.8 within about 33 and 50 ft. of the nest and 16.8 at a distance of about 50-100 ft. The range of these ants thus appears to be very limited; they are not very common in Mecklenburg, and their nests are destroyed in winter by wild boars.

A comparative survey in May 1939 showed that averages of approximately 43 and 31 per cent. of *Bupalus* pupae were parasitised in mixed and unmixed stands, respectively. The most abundant parasites in both types of forest were *Ichneumon nigrivittatus*, Grav., and *Anomalon biguttatum*, Grav. [cf. 19 615], which together formed about two-thirds of the parasites reared. The others were, in order of abundance, *Blondelia* (*Lydella*) *nigripes*, Fall., *Platylabus histrio*, Wesm. (in mixed stands only), *Carcelia rutila*, B. & B., and *Heteropelma calicator*, Wesm. Single examples of a species of *Ichneumon* tentatively identified as *I. pachymerus*, Htg., and of *Aptesis* (*Microcryptus*) sp. were found in mixed stands. Arthropod predators afforded some control of pupae, and many were destroyed by rodents in mixed forests.

The author concludes that the less severe infestation of pines in mixed forests in Mecklenburg cannot be attributed to the higher rate of pupal parasitism, even if this factor is constant, and advocates further research, preferably in forests further from the coast, where the Geometrid is sufficiently numerous between outbreaks for the influence of predators and parasites to be studied over a number of years.

SCHULZ (H.). Beiträge zur Arsenempfindlichkeit der Honigbiene, unter besonderer Berücksichtigung des Grenzwertes der Vergiftung. [Contributions to the Susceptibility of Honey-bees to Arsenic, with special Consideration of the Threshold of Toxicity.]—*Z. angew. Ent.* 27 pt. 4 pp. 655-666, 3 graphs, 18 refs. Berlin, 1941.

In view of the high mortality of honey-bees associated with the widespread use of sprays of calcium arsenate against the potato beetle [*Leptinotarsa decemlineata*, Say] in Germany since 1936, laboratory tests were carried out to

determine the susceptibility of bees to arsenic. Individual bees kept at a constant temperature and humidity were given single graduated doses of a commercial calcium-arsenate preparation containing 37.2 per cent. total arsenic pentoxide, diluted to contain 0.0485 mmg. metallic arsenic per cc. The results showed that the length of life of the bees was reduced by a dose of 0.15 mmg. arsenic (As) and varied in inverse ratio to the amount of arsenic consumed up to 0.5 mmg. but remained fairly constant at about 2-3 days for doses of 1 and 1.5 mmg. A dose of 10 mmg. killed all bees in 1-2 hours. Untreated bees lived for an average of 22 days. It was observed that bees poisoned in the field by arsenical sprays were unable to fly, usually died within a few hours, and contained only 0.26 mmg. arsenic, but when fed in favourable conditions in the laboratory even severely affected individuals survived for some days. The author considers that in view of the short life of the bee and the slow toxic action of arsenic, a minimum lethal dose can be established only within specified time limits, and concludes from a review of the literature [cf. *R.A.E.*, A 14 408; 22 267] that the amount of arsenic normally present in the bee is 0.1 mmg. and that any amount greater than this may cause mortality.

To determine the effect on bees of repeated doses of arsenic such as they are likely to obtain in the field, a swarm was allowed to ingest sublethal doses of sodium metarsenite in sugar solution on alternate days for 20 days, during which no toxic symptoms were observed. Single doses of 0.4 or 0.35 mmg. arsenic as calcium arsenate shortened the life of samples of bees taken from the swarm before and after this conditioning, but samples taken after conditioning and given these doses or none did not live so long as the corresponding samples taken before it. It is therefore concluded that even sublethal doses of arsenic have a weakening effect on the population, similar to that of prolonged hunger.

LAMAS C. (J. M.). **Observaciones sobre insectos del algodónero en Chira, Piura, Pativilca, Supe y Huaura.** [Observations on Pests of Cotton in the Valleys of Chira, Piura, Pativilca, Supe and Huaura].—*Inf. Estac. exp. agric. La Molina* no. 59, 75 pp., 4 figs. Lima, 1945.

An entomological substation was established at Piura at the end of 1941 for the study of cotton pests in the valleys of Chira and Piura, in northern Peru, and the greater part of this publication consists of notes on the seasonal occurrence and in some cases control of the species observed in 1942 and 1943, each valley and year being considered separately. Among the more important pests in both valleys was *Dysdercus ruficollis*, L., which did not cause serious damage in 1942, except in high districts, owing to drought, but was plentiful in 1943, particularly on early and medium sowings, in spite of the one month's close season in which no cotton was present. The recommended close season is two months, and simultaneous sowing throughout the region is also advised, but the growers are disinclined to co-operate in this [cf. *R.A.E.*, A 32 429]. The Tachinids, *Paraphoranthia peruviana*, Tns., and *Acaulona peruviana*, Tns., which parasitise *D. ruficollis*, exercised little control at any time. Field tests on control were carried out in 1943 with a proprietary spray which was applied three times during the season and gave satisfactory results. *Anthonomus vestitus*, Boh., caused serious injury in 1942. It was observed that in cotton of the variety Pima and in *Gossypium peruvianum*, the tip of the bud was attacked, instead of the base, so that the flower was not prevented from opening, but the peduncle was often severed by the female after oviposition, causing the bud to fall. Young bolls were infested at the end of the flowering season. Various arsenicals, including dusts and sprays of calcium arsenate and a spray of Paris green, were tested for control of the weevil, but the results were unsatisfactory. In 1943, partly due to the one month's close season, its appearance was delayed

and only late sowings were attacked. Control by natural enemies was in general ineffective in both years, but parasitism by *Triaspis versticida*, Vier., reached 39 per cent. in the upper Piura Valley in May 1943. *Bucculatrix thurberiella*, Busck, which was favoured by the dry weather, caused considerable injury to the leaves in 1942. In July 1943, a type of injury hitherto unknown in these valleys was found to be caused by larvae of a closely related species thought to be *B. gossypiiella*, Morrill [cf. 15 542], which mined superficially in stems, branches, leaf and flower stalks, leaf veins, bracts and green bolls, causing complete cessation of growth. In the same year *Alabama argillacea*, Hb., was very numerous in early summer, and rain washed off the arsenicals that were applied against it. Better control was obtained later in the year. Of its natural enemies, the most important was the egg-parasite, *Trichogramma minutum*, Ril. *Aphis gossypii*, Glov., was responsible for some shedding in both years, particularly where arsenical dusts were used; these were thought to be more destructive than sprays to its natural enemies, which include Coccinellids and other predacious insects.

Pests observed on other crops in these valleys included *Selenothrips rubrocinctus*, Giard, on peas and beans in 1942, and *Stegasta bosquella*, Chamb., on ground-nuts, *Hellula undalis*, F., on cabbage and cauliflower, and *Laphygma frugiperda*, S. & A., *Diatraea saccharalis*, F., and *Blissus leucopterus*, Say, on maize in 1943.

The remainder of the publication consists of notes on various pests of cotton in the valleys of Huaura, Supe and Pativilca, near Lima, in the season 1943-44. The crop was satisfactory, and *Dysdercus ruficollis*, which had been very injurious in the previous season, was not in evidence during the summer. *Aphis gossypii* caused some shedding in January and February, and its predator *Cycloneda sanguinea*, L., was parasitised by the Encyrtid, *Homalotylus flaminus*, Dalm. *Anthonomus vestitus* was present in all three valleys, and infestation reached 88 per cent. during the main flowering period in Supe. *Mescinia peruella*, Schaus, was fairly injurious to the bolls in some fields, and larvae of *Pyroderces rileyi*, Wlsm., which had been thought to be a secondary pest only, were found boring in the shoots and leaf-stalks, chiefly in lower Supe and Pativilca.

GOÑÇALVES (C. R.). **O gergelim no combate à saúva.** [*Sesamum orientale* in the Control of Leaf-cutting Ants.]-*Bol. fitossanit.* 1 (1944) no. 1 pp. 19-27, 1 fig., 23 refs. Rio de Janeiro, 1945.

The author reviews the Brazilian literature on the disputed claim that the leaves of *Sesamum orientale* (*indicum*) are toxic to leaf-cutting ants or to the fungus that they cultivate in their nests [cf. *R.A.E.*, A 14 240; 17 280]. In view of a recent revival of this claim, an experiment was undertaken in which a newly founded nest of *Atta sexdens rubropilosa*, Forel, containing its queen, was placed in a glass vessel and young plants of *S. orientale* were set in a tin of earth near the nest. The ants displayed great activity in cutting the leaves and even parts of the stems. After a month the nest was opened, and larvae and pupae of all sizes were seen in good condition, while the fungus showed excellent development of mycelium. The experiment was continued with cut *Sesamum* leaves in water substituted for the growing plants. After a further month, all larvae and pupae were again found to be in good condition, and the sap of the plant was evidently not harmful to the ants, since the workers that cut the leaves were not poisoned. When the ants in an artificial nest were offered a choice between *Sesamum* and rose leaves, they at first showed a preference for the former, but after a few days returned to the rose leaves. The ants were attracted by *Sesamum* while the plants were tender but not after they were three months old.

D'ARAUJO E SILVA (A. G.). **Nota sôbre *Homalotylus flaminus* (Dalman, 1820). (Hym.-Encyrtidae).** [A Note on *H. flaminus*.]—*Bol. fitossanit.* 1 (1944) no. 1 pp. 29–35, 2 figs., 7 refs. Rio de Janeiro, 1945.

An Encyrtid found parasitising the larvae of *Cycloneda sanguinea*, L., in Brazil was identified by Costa Lima as *Homalotylus flaminus*, Dalm., of which he considers *Lepidaphycus bosqi*, Blanch. [cf. *R.A.E.*, A 25 787; 26 289] and *H. mirabilis*, Brèth., to be synonyms. The author agrees with this view and states that Blanchard has informed him that *L. bosqi* is a synonym of *H. mirabilis*. The hosts and distribution of *H. flaminus* are reviewed from the literature, and the adult is described.

SMITH (H. D.). **La "mosca prieta" de los cítricos en la Costa Occidental de México y la importación y colonización de *Eretmocerus serius* Silv. para su control.** [The Citrus Blackfly on the West Coast of Mexico and the Importation and Distribution of *E. serius* for its Control.]—*Fitófilo* 4 no. 2 pp. 67–103, 1 map. San Jacinto, D.F., Mex., 1945.

*Aleurocanthus woglumi*, Ashby, is a serious pest of *Citrus* on the west coast of Mexico. It was first observed in that country in the State of Sinaloa in 1935 and was later found in further localities there and in the State of Colima, to the south. Attempts to introduce the parasite, *Eretmocerus serius*, Silv., from Costa Rica in 1936 and from the Panama Canal Zone in 1938 were unsuccessful, and since the continued spread of the Aleurodid would constitute a threat to *Citrus* in California and other border regions of the United States, a further attempt was made in 1943 by United States and Mexican authorities to establish this Eulophid in Mexico [cf. *R.A.E.*, A 34 179].

The chief *Citrus* orchards of the region are in Colima, those in the States further to the north being smaller and more scattered. A survey showed that the Aleurodid was present in Colima and the neighbouring parts of Jalisco, parts of Tepic and Nayarit and throughout Sinaloa up to the northern boundary; the infested areas are shown on a map. The extent of infestation was very variable; in some orchards only one or two trees were attacked, while in others nearby 80–90 per cent. of the leaves showed the characteristic sooty mould on the underside. It was thought that the insect was mainly disseminated by the railways, the adults settling on plants during transit. The life-cycle in these regions lasted about six weeks, the generations overlapping slightly. In dry districts, the emergence of the adults was delayed, and prolonged drought killed many of the larvae and pupae and still more of the eggs. Infestation was generally heaviest between August and January, and the climate in most parts of the west coast was sufficiently damp to favour it.

The preferred food-plants were lime and lemon, followed by orange, tangerine and grapefruit. Infestation was often severe on *Diospyros ebenaster*, *Lucuma mammosa* and *Psidium sartorianum*, moderate on mango and usually light on coffee. Eggs were commonly laid on *Murraya exotica*, but the larvae were unable to complete their development on this tree, so that it might prove a useful trap crop to protect mango or other less strongly preferred plants. The chief effect on the trees consists in loss of vigour through defoliation, as most of the infested leaves fall in the dry season. This weakening caused a considerable reduction, up to 80 per cent. in some cases, in the production of *Citrus* fruit, and was thought to have resulted in the death of several trees in different districts. The Coccinellid, *Delphastus pusillus*, Lec., was predacious on *A. woglumi* in Sinaloa and exerted some control, and Chrysopid larvae destroyed small numbers of the larvae of the Aleurodid in all districts.

The supplies of *E. serius* were obtained from consignments of infested *Citrus* leaves collected in the Panama Canal Zone and sent by air between 26th May and 26th June to Mexico City, where they were kept at a temperature of 10–15°C.

[50–59°F.] and despatched again by air the next day or later to the west coast. The larger consignments were packed in cloth bags together with crumpled paper and the bags were arranged among paper shavings in well ventilated boxes. The parasites survived well in these conditions, but the adults died in little more than a day if ventilation was not sufficient to remove the gases given off by the leaves.

The total air journey averaged  $2\frac{1}{2}$  days, and the final stages were completed by car or by train. The bags were then opened in boxes, light at one end to attract the adult parasites, and the latter were collected by suction into glass tubes, in which they were kept until liberated. A certain amount of trouble was experienced with these owing to condensation of moisture on the sides, which caused the death of the insects. The parasites were released directly on to infested trees, usually lemons, at rates to give about 100–500 females to a five-acre orchard; females represented at least 75 per cent. of the adults in samples of the parasite population. A list is given of the sites and dates of liberation, and of the number of insects released on each occasion. In all, 8,767 adults were released at 60 points in 15 districts in Colima, Tepic and Sinaloa in June and July. In three places in Sinaloa, adults were observed about a month after release, and these evidently represented a new generation, as the original adults could not have survived so long; in one place, many pupae of the Aleurodid showed emergence holes characteristic of the parasite. Arrangements were made for collection and further distribution of parasitised material in the orchards.

GRAY (H. E.). **The Use of DDT in the Control of Stored Product Pests.**—*Pests* 13 no. 11 p. 28. Kansas City, Mo., 1945.

The author discusses, with reference to conditions in Canada, the disadvantages and, in view of the lack of definite knowledge regarding its toxicity to man and the higher animals, the undesirability of using DDT against insect pests that infest stored products or occur in buildings in which food materials are processed. In flour mills, insects are chiefly concentrated in the machines used in the processing and separation of the various streams of materials, but treating the inner surfaces of these machines and of storage bins with DDT to provide a toxic residue would be of little value, since the movement of the contents would remove the crystals from the walls; moreover, the DDT would become mixed with the food products. In grain elevators, the layer of dust that settles on the walls and ceiling during the filling process would prevent direct contact between the insects and the toxic residue. In the laboratory, DDT has given good control of insects when mixed with grain at quite low concentrations, but infestation is not sufficiently frequent in Canada to justify treating all grain at the time of storage, and measures that can be used against local infestations as they develop are more economical. When grain bins were treated experimentally with aerosols containing 5 per cent. DDT or pyrethrum extract, the mortality of larvae of the Indian meal moth [*Plodia interpunctella*, Hb.] after 42 hours was only slight for the former but reached 85 per cent. for the latter.

STEINHAUS (E. A.). **Insect Microbiology. An Account of the Microbes associated with Insects and Ticks with special Reference to the biologic Relationships involved.**— $9\frac{1}{2} \times 6$  ins., x+763 pp., 250 figs., 89 pp. refs. Ithaca, N.Y., Comstock Publ. Co. Inc.; London, Constable & Co., Ltd., 1946. Price \$7.75 or 45s.

The author here co-ordinates information, which was previously available only in a widely scattered and often inaccessible literature, on the various relationships and associations that exist between micro-organisms (including viruses) and insects, ticks and mites. They are considered under the headings of

extracellular bacteria, specific bacteria associated with Arthropods, intracellular bacterium-like and rickettsia-like symbiotes, rickettsiae, yeasts, fungi, viruses, spirochaetes, Protozoa associated with termites and Protozoa associated with other Arthropods, and the relationships discussed include those in which the Arthropods transmit agents pathogenic to man, other animals and plants, those in which they are themselves attacked by pathogenic agents, and those in which the association is harmless or beneficial to them. One chapter deals with immunity in insects and the factors conferring it, and methods and techniques for rearing and studying insects, ticks and the various micro-organisms in the laboratory are given in another.

HODSON (A. C.) & ZEHNGRAFF (P. J.). **Budworm Control in Jack Pine by Forest Management.**—*J. For.* **44** no. 3 pp. 198–200, 5 refs. Washington, D.C., 1946.

Studies carried out in northern Minnesota since 1939 confirmed Graham's observations that staminate flowers of *Pinus banksiana* are of great importance in the diet of larvae of the form of *Harmologa (Archips) fumiferana*, Clem., that attacks pines and that outbreaks are therefore the result of an abundance of staminate flowers, which are produced most commonly in large-crowned, open-grown trees and suppressed trees [cf. *R.A.E.*, A **23** 698]. It was also observed that trees not bearing an abundance of staminate flowers may suffer considerable defoliation during a season immediately after one in which the Tortricid has built up a large population; apparently such trees become so heavily infested with young larvae that enough survive to cause damage, though relatively few mature. Although susceptibility to attack by the budworm usually increases with the size of the tree, young trees often flower and may develop staminate flowers for several years in succession. Staminate flowers are usually borne on the lower half of the crown and pruning to free the lower bole from knots would tend to reduce the number of these flowers and make young trees less susceptible to damage. Since suppressed trees in a stand often produce abundant staminate flowers and are infested with *H. fumiferana* while others are uninfested and without staminate flowers, they may provide sources of infestation in seasons in which staminate flowers occur generally throughout the stand. A field examination of a well-stocked stand 35 years old, carried out in May 1944 to gain more specific information on staminate-flower production in *P. banksiana*, showed that suppressed and intermediate trees and most of the orchard-type trees bore a heavy crop of flowers as compared with codominant trees, and that trees of poor vigour, as indicated by thin crowns and short needles, showed a much greater abundance of staminate flowers than vigorous ones. Infestation by the Tortricid was heaviest on the least vigorous trees.

As soon as suppression occurs in a natural stand of *P. banksiana* reproduction, the suppressed trees begin to flower heavily and are infested with budworms, so that frequent thinnings for pulpwood and other small products should be made to remove trees that have become suppressed or appear likely to become so and to keep the crowns of the most desirable trees vigorous or productive. This treatment would probably reduce the budworm population in the stand to a level at which serious outbreaks would be less likely.

KELSHEIMER (E. G.). **Notes on the Great Elm Leaf Beetle.**—*Florida Ent.* **28** no. 2 pp. 25–27, 1 fig. Gainesville, Fla., 1945.

*Monocesta coryli*, Say, completely defoliated two elm trees at Bradenton, Florida, in the spring of 1944 and others, later in the year, in 1945, when damage on the trees originally infested was prevented by heavy parasitism. Most of the injury is caused by the larvae, but the adults feed for a short time in spring. The eggs of this Galerucid are deposited in masses on the lower surface of the

leaves and hatch in a fortnight. The larvae crawl to the ground when fully fed and enter the soil where they overwinter. Larvae that entered the soil in July 1944 and were kept in the insectary began to pupate on 9th February 1945 and the first adult emerged on 10th March. Emergence was first observed in the field on 8th April and mating and oviposition on 11th May.

WATSON (J. R.). **Whiteflies on Gardenias.**—*Florida Ent.* **28** no. 2 pp. 30–31. Gainesville, Fla., 1945.

The citrus whitefly [*Dialeurodes citri*, Ril. & How.] is one of the most important pests of gardenia in Florida and is more injurious to it than to *Citrus*, since the leaves continue to be attractive as long as they remain on the plant and are consequently attacked by two or all of the three main generations that occur each year. Infestation is frequently so severe that the plants are almost completely defoliated. Control measures should be applied against each generation. Only highly refined oil emulsions should be used in sprays [*cf.* *R.A.E.*, A **27** 530], since the leaves are easily scorched. The adults can be destroyed by sulphur dusts, but several applications are required against each generation, since the sulphur remains effective for only a few days.

CHANDLER (S. C.). **Codling Moth Studies of 1944.**—*Trans. Ill. hort. Soc.* **1944** **78** pp. 125–139, 2 figs. Quincy, Ill. [1945.]

In an attempt in Illinois to destroy the hibernating larvae of the codling moth [*Cydia pomonella*, L.] on apple trees in the dormant season [*cf.* *R.A.E.*, A **32** 273 etc.], a spray of 4 lb. dinitro-o-cresol with either 4 lb. fish-oil soap and 10 U.S. gals. fuel oil or 6 U.S. gals. Dendrol [a miscible oil for dormant sprays] per 100 U.S. gals. water was applied thoroughly on 22nd–24th March to the trunks and main branches as far as there was rough bark (up to a height of 10 ft. or more on some trees) and to the ground for a distance of 1–3 ft. from the trunk. The highest percentage of larvae found dead in subsequent examinations was 71 and enough survived to give rise to a moderately heavy infestation in early spring, after which no reduction in spray schedules was possible. The spray containing Dendrol penetrated more slowly than that containing fuel oil, but was about as effective. In most cases in which the fuel-oil spray reached behind the pieces of rough bark sufficiently to wet the cocoons, the larvae inside died. A little injury occurred to some of the low-hanging terminal branches that were accidentally hit by the spray, but this was not important.

In tests carried out during the growing season to compare some commonly used materials or spray schedules, a calyx spray, a top-off spray, three cover sprays and another top-off spray [*cf.* **31** 463] were applied at weekly intervals against the first generation and, after an interval of a fortnight, 3–6 sprays against the second. As the overwintered population was large and orchard sanitation poor, infestation by the first generation was moderately high for all treatments, in spite of rainy weather unfavourable to moth development, and infestation at harvest was very severe after favourable weather from the middle of June. It was more severe at the tops of both treated and untreated trees. A shorter interval between first-generation and second-generation sprays and additional late applications would probably have improved control.

The results obtained showed the superiority of fixed nicotine (chiefly Black Leaf 155) over lead arsenate in hot dry weather; it gave better control and a better general appearance of the fruit and foliage and reduced infestation by leafhoppers. Sprays of lead arsenate in weak Bordeaux mixture gave better control and a better appearance of fruit and foliage than those containing lead arsenate and lime only. Black Leaf 155 [14 per cent. fixed nicotine] was at least as effective at the rate of 1½ lb. per 100 U.S. gals. at weekly intervals against both generations as at 3 lb. at weekly intervals against the first and

2½ lb. at ten-day intervals against the second. A split schedule of lead arsenate until the second cover spray, lead arsenate with Black Leaf 155 in the third and fourth and Black Leaf 155 in the rest was as effective as a complete schedule of nicotine, except where the crop was light.

A subsidiary test showed that there was little improvement in the control given by a lead-arsenate spray when it was applied by means of a Speedsprayer [cf. 34 195, 196] as compared with ordinary power equipment.

STEINER (L. F.), SUMMERLAND (S. A.) & FAHEY (J. E.). **Experiments with DDT for Codling Moth Control at the Vincennes, Ind. Laboratory.**—*Trans. Ill. hort. Soc.* 1944 **78** pp. 153–169, 3 refs. Quincy, Ill. [1945.]

The results are given of experiments carried out in Indiana in 1944 in which DDT was compared with lead arsenate and nicotine bentonite (a tank mixture of nicotine sulphate and Mississippi bentonite) for the control of the codling moth [*Cydia pomonella*, L.] on apple. Those of preliminary tests in 1943 [R.A.E., A 32 385–386] are briefly reviewed. In one series of tests in 1944, trees that had received a uniform calyx spray containing lead arsenate were given eight cover sprays of the material to be tested, all at the rate of about 30 U.S. gals. spray per tree, between 19th May and 14th August. In the lead-arsenate programme, an additional application was made seven days after the calyx spray. Two plots were dusted with 2½–3 lb. 5 per cent. DDT per tree on the same dates. Rainfall totalled 5 ins. during this time and 5.67 ins. between 14th August and harvest (1st September). Samples of apples were taken from the trees before and after each spray from the second cover spray onwards and exposed to attack by newly hatched larvae in the laboratory. All spray quantities for this and subsequent tests are given per 100 U.S. gals., and Bordeaux mixture (½ : 1 : 100) was always included with lead arsenate. Technical DDT ground in a ball mill with water or with pyrophyllite was used for the DDT sprays.

The average percentages of larvae killed 0–2 and 7–18 days after applications and at harvest were, respectively : 97, 85 and 60 for a schedule of 1 lb. DDT and 9 lb. pyrophyllite in the first five sprays and ¾ lb. DDT and 6¾ lb. pyrophyllite in the rest ; 97, 82 and 59 for one of 1 lb. each of DDT and pyrophyllite in the first two, 1 lb. DDT water paste in the three following and ¾ lb. DDT water paste in the last three ; 97, 81 and 46 for one of 1 lb. each of DDT and pyrophyllite in the first five sprays and ¾ lb. of each in the rest ; 99, 90 and 94 for this third schedule with the addition of 1 U.S. quart mineral oil and ¼ lb. Wyoming bentonite in each application ; 99, 89 and 85 for the third schedule with Bordeaux mixture (1 : 2 : 100) ; 64, 52 and 50 for lead arsenate at 4 lb. in the first four sprays, the last three of which included 2 U.S. quarts mineral oil, and at 3 lb. in the last four ; 94, 82 and 73 for 1 U.S. pint nicotine sulphate and 8 lb. Mississippi bentonite with the addition of 1 U.S. pint soy-bean oil in the first spray, 1 U.S. quart soy-bean oil in the second and 2 U.S. quarts mineral oil in the third and fourth, and ¾ U.S. pint nicotine sulphate and 5 lb. bentonite with 2 U.S. quarts mineral oil in the fifth, sixth and seventh and 1 U.S. quart soy-bean oil in the eighth ; 81, 41 and 32 on plots dusted with 5 per cent. DDT in talc and pyrophyllite, with the addition of 5 per cent. oil in the first four dusts ; and 87, 48 and 30 on those dusted with 5 per cent. DDT in walnut-shell flour. All the DDT spray schedules were thus superior to lead arsenate, but only the last two were better than nicotine bentonite at harvest ; these proved highly resistant to heavy rains that occurred late in August. The deposits of the most effective treatment were nearly twice as heavy as those of any other DDT treatment. The rate of loss of efficiency between sprays became less as the season advanced, because of the declining rate of fruit growth, better distribution of deposits and the increase in deposit from additional applications ;

It was possible to achieve and maintain higher efficiency early in the season with DDT sprays than with any other insecticide tested during the previous ten years. The dusts rapidly lost effectiveness between applications. They were more toxic to predaceous insects than the sprays, but both were injurious. The European red mite [*Paratetranychus pilosus*, C. & F.] increased rapidly during June on most of the DDT plots. Defoliation due to it began in August in the dusted plots, and all the plots sprayed with DDT were completely defoliated by late October except the one receiving DDT, pyrophyllite, mineral oil and bentonite. On the latter, very few mites reached the adult stage. The amount and time of defoliation were directly associated with mite infestation and bore no relation to the amount of DDT residue on fruit and foliage. Neither *P. pilosus* nor the common red spider [*Tetranychus*], though generally present in most orchards in southern Indiana, normally causes any noticeable damage to apple foliage when standard lead arsenate or nicotine bentonite is used.

Field tests were carried out on individual well-pruned trees about 25 years old, which each required 25-35 U.S. gals. spray per application. Ten cover sprays were applied from a tower and from the ground and from the inside as well as the outside of the trees. Lead arsenate was applied at the rate of 4 lb. with soy-bean flour in the first regular cover spray, 4 lb. with 2 U.S. quarts mineral oil in the next three and 3 lb. in the last six, with an extra application of 4 lb. between the calyx and first regular cover sprays, and nicotine sulphate at 1 U.S. pint with 8 lb. bentonite and 1 U.S. pint mineral oil or 1 U.S. quart soy-bean oil in the first spray, at 1 U.S. pint with 8 lb. bentonite and 2 U.S. quarts mineral oil or 1 U.S. quart soy-bean oil in the next three, the ninth and the tenth, and at  $\frac{2}{3}$  pint with 5 lb. bentonite and 2 U.S. quarts mineral oil or 1 U.S. quart soy-bean oil in the sixth, seventh and eighth. Under the weather conditions of 1944, which were highly favourable to *C. pomonella*, it was impossible to secure adequate control of a heavy infestation with these programmes alone (10-24 and 56-67 per cent. uninjured apples for the lead-arsenate and nicotine bentonite treatments, respectively), although they are the most effective known; it is considered that better results would have been obtained with the nicotine sprays if the concentration had not been reduced in the sixth, seventh and eighth sprays, but supplementary measures, such as scraping and banding, are essential if these schedules are to give satisfactory control. A schedule of 1 lb. each of DDT and pyrophyllite in the first five and last two sprays and  $\frac{2}{3}$  lb. each in Bordeaux mixture with 2 U.S. quarts mineral oil in the sixth and seventh and without it in the eighth, and the same schedule without oil or Bordeaux mixture gave 72 and 67 per cent. uninjured apples, respectively, though they were generally less effective than nicotine bentonite in controlling superficial injuries. A schedule of 1 U.S. pint nicotine sulphate and 8 lb. bentonite with 1 U.S. pint mineral oil in the first spray and 2 U.S. quarts in the second, followed by eight sprays of  $\frac{1}{2}$  U.S. pint nicotine sulphate, 4 lb. bentonite, 2 U.S. quarts mineral oil and 4 oz. each of DDT and pyrophyllite, and a schedule of 4 lb. lead arsenate and 4 oz. each DDT and pyrophyllite with 4 oz. soy-bean flour in the first spray and 2 U.S. quarts mineral oil in the second, and 2 lb. lead arsenate and 4 oz. each DDT and pyrophyllite in the remainder, with the addition of 2 U.S. quarts mineral oil in the third and fourth, gave 83 and 50 per cent. uninjured apples, respectively; at this strength DDT may not cause an excessive increase of mites. Almost complete control (90 per cent. uninjured apples) was obtained with 1  $\frac{1}{2}$  lb. each of DDT and pyrophyllite in the first five, the ninth and the tenth sprays, and 1 lb. each of DDT and pyrophyllite in the sixth, seventh and eighth with the addition of 4 oz. Wyoming bentonite and 2 U.S. quarts mineral oil in the sixth and of 3 U.S. quarts mineral oil in the seventh; and the addition of 4 oz. Wyoming bentonite and 2 or 3 U.S. quarts mineral oil to the sixth and seventh sprays, respectively, of a schedule of  $\frac{2}{3}$  lb. each of DDT and pyrophyllite in the first five, the ninth and the tenth and  $\frac{1}{2}$  lb. each of DDT and pyrophyllite in the sixth, seventh and eighth increased its effectiveness for the

rest of the season (63 per cent. uninjured apples) to that of the one comprising higher concentrations of DDT and pyrophyllite only. At the strengths used, the effect of the mineral oil on *P. pilosus*, which began to cause noticeable injury on some of the trees in July, was negligible, but most of the trees showed no bronzing of foliage, and those treated with the highest concentration of DDT were the least injured at harvest, late in September, indicating that it may be possible to control mites with higher concentrations of DDT. A schedule of DDT water paste at  $\frac{3}{4}$  lb. in the sixth, seventh and eighth sprays and 1 lb. in all the others gave 46 per cent. uninjured fruit. Lead arsenate and nicotine bentonite gave approximately equal control of infestation by first-generation larvae, both being less effective than DDT, but after the change to hot dry weather, the percentage of larvae killed by the standard lead-arsenate treatment declined on one variety from 86 per cent. after the third cover spray to 51 per cent. after the fifth, although the deposits of arsenic trioxide were approximately the same. During the early part of the season, arsenical residues were heavier than those of DDT, but from 20th July to 17th September, DDT was much more resistant to weathering and heavier residues accumulated; both DDT and nicotine bentonite gave excellent control from mid-August onwards. Lead arsenate caused various degrees of plant injury, and the bronzing of foliage on some trees sprayed with DDT appeared to be responsible for poor coloration of the fruit.

In large-scale tests in a heavily infested orchard in which lead arsenate had failed to give effective control in 1943, five cover sprays of 1 lb. each of DDT and pyrophyllite followed by five of  $\frac{3}{4}$  lb. of each between 16th May and 29th August, with the addition of 0.75 per cent. mineral oil and Bordeaux mixture ( $\frac{3}{4}$  :  $1\frac{1}{2}$  : 100) in the sixth spray on some varieties, gave an average of 67 per cent. uninjured apples, as compared with 45 per cent. for 11 cover sprays of nicotine bentonite and oil between 17th May and 23rd August. Deposits of DDT and nicotine bentonite on the foliage, where most eggs are laid, are much more toxic to the larvae than those of lead arsenate, but nicotine deposits on fruit permit more movement of larvae than DDT and result in a higher proportion of calyx entrances than either DDT or lead arsenate. Apples sprayed with DDT showed more superficial injuries than those treated with nicotine bentonite, but most of them were small, the larvae apparently dying just after they cut through the skin and before they could do any further damage to the fruit, such as often occurs when lead arsenate is used. At the beginning of the experiment, an average of 227 moths per trap was taken in each area, indicating that the population was uniformly heavy. The nicotine sprays caused an immediate decline in moth abundance, whereas the DDT showed no effect until 2-3 days after application, but in the second half of the season, traps in the DDT area averaged 313 moths each, and those in the nicotine area 540. The amounts of spray applied per tree were about 20 per cent. less than in the previous tests, and though *P. pilosus* became noticeably abundant on some trees sprayed with DDT early in July, and *Tetranychus* later in that month, the deposits were apparently light enough to permit the survival of predators and there was no serious outbreak.

Leafhoppers and the woolly apple Aphid [*Eriosoma lanigerum*, Hsm.] were almost completely destroyed on DDT plots, but abundant on trees sprayed with lead arsenate. In the spring of 1944, the other three species of Aphids common on apple [*Rhopalosiphum prunifoliae*, Fitch, *Anuraphis roseus*, Baker, and *Aphis pomi*, Deg.] were absent from the plots in which DDT had been most effective against *C. pomonella* in 1943, whereas as many as 91 per cent. of the buds on adjacent plots were infested. It was at first thought that this was due to the effect of the deposit of DDT on the Aphids in the autumn [cf. 33 218], but it is now considered that the early defoliation caused by the heavy mite infestations and dry weather was partly responsible. The tarnished plant bug [*Lygus oblineatus*, Say] and the striped and spotted cucumber beetles [*Diabrotica*

*melanocephala*, F., and *D. duodecimpunctata*, F.), of which the last sometimes injures apples, were frequently found dead in the DDT plots, but little if any control of crawlers of the San José scale [*Quadraspidiotus perniciosus*, Comst.] was observed.

CHANDLER (S. C.). **Peach Insect Problems of 1944.**—*Trans. Ill. hort. Soc.* 1944 **78** pp. 339–348. Quincy, Ill. [1945.]

The percentage of orchards in southern Illinois that were heavily infested in November with the San José scale [*Quadraspidiotus perniciosus*, Comst.] increased from 7.1 in 1943 to 41.7 in 1944 for apple and from 20 to 69.9 for peach. Infestation was light in the northern half of the State. There was a marked reduction in the proportion of peaches showing cat-facing [cf. *R.A.E.*, A **33** 316], but although the percentage of scarred fruit at harvest in certain orchards fell from 18.9 per cent. in 1943 to 5.7 in 1944, jarring of the trees from the time the blossoms opened in spring to the end of May resulted in counts of 491 and 531 curculios [*Conotrachelus nenuphar*, Hbst.], 47 and 33 tarnished plant bugs [*Lygus oblineatus*, Say] and 85 and 65 Pentatomids in the two years, respectively. This indicated that some factor other than total number of insects, possibly weather conditions, was responsible for much of the reduction in injury; a somewhat larger crop accounted for some of it. Jarring the trees between late March and late July showed that *L. oblineatus* appears on peach when the blossoms are just beginning to open and has reached its peak by the time all the petals have fallen; that Pentatomids do not appear in appreciable numbers before the sepals begin to crack, but remain until all sepals have fallen, at the end of May; and that *C. nenuphar* is an important cause of cat-facing when abundant. In four of five orchards there was a direct correlation between numbers of this weevil and cat-facing. Cage tests indicated that the presence of *L. oblineatus* is less important when the blossoms are opening than later, as the earlier injury results in the dropping of blooms rather than in deformation of the fruit, and that petal-fall is probably the most important time for control. Pentatomids were found to produce injury for as long as they were present. Although leguminous plants in or near peach orchards have apparently increased the proportion of cat-facing in previous years [cf. **33** 317], no correlation was found in 1944.

A dust of 4 per cent. nicotine in sulphur, and others containing pyrethrum or rotenone gave no control of the cat-facing. Basic lead arsenate was compared with acid lead arsenate, both with safeners, in dusts and sprays for the control of *C. nenuphar*, but the results were inconclusive as regards both control and leaf and twig injury.

HOUSER (J. S.). **Status of Ohio Wheat Pests in 1945.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **30** no. 236 pp. 164–166, 1 map. Wooster, Ohio, 1945.

Infestation of wheat in Ohio by the Hessian fly [*Mayetiola destructor*, Say], which fell from 25.7 per cent. in 1942 [cf. *R.A.E.*, **30** 411] to 4.3 and 3 per cent. in 1943 and 1944, increased to 8.4 per cent. in 1945 and was expected to be still higher in 1946. The safe sowing dates are shown on a map. Other common insect pests of wheat were of little importance, but light infestation by the chinch bug [*Blissus leucopterus*, Say] was observed in some wheat fields in the west of the State. Two or three weeks before the wheat harvest, nymphs of *Philaenus leucophthalmus*, L., in large deposits of white froth, were numerous on clover, lucerne and various grasses and weeds in many parts of Ohio. At about the time that the wheat ears began to appear, the bugs matured and flew to the wheat fields, where they settled on the ears. As many as 15–20 were found feeding on some ears, but the damage caused was very slight.

JONES (H. A.), FLUNÓ (H. J.) & MCCOLLOUGH (G. T.). **Solvents for DDT.**—*Soap & sanit. Chem.* **21** no. 11 pp. 110–113, 115, 155, 3 refs. New York, N.Y., 1945.

Extensive investigations have been carried out in Florida on the solubility of DDT in a wide range of solvents suitable for use in preparations for the control of insects affecting man. Solubility was determined by a simple synthetic method and a refractive index method, both of which are described. Most solvents were tested by both methods.

The results are set out in a table giving the solubility of DDT in gm. per 100 ml. and per 100 gm. of each solvent at 27–30°C. It shows that several ketones (acetophenone, cyclohexanone, methyl isobutyl ketone, isophorone and mesityl oxide) have high solvent power for DDT, as also have the aromatic hydrocarbons (benzene, xylene, etc.), the chlorinated aliphatics (methylene chloride, trichlorethylene, etc.), the chlorinated aromatics (chlorbenzene, orthodichlorobenzene, etc.), and some ethers (dioxane, anisole, etc.). Several esters (ethyl benzoate, tributyl phosphate, etc.) and the one lactone tested ( $\gamma$ -valerolactone) are good or moderately good solvents. The aliphatic petroleum fractions are comparatively poor, but have the advantage of being readily available in many areas. Some, such as crude kerosene and fuel oil, are variable in composition, and the solubility of DDT in them may be expected to vary with different samples. Aromatic petroleum fractions generally dissolve rather large proportions of DDT, and many of them are being used as auxiliary solvents. DDT is generally very soluble in aromatic fractions obtained from coal tar, but is not highly so in cresylic acid. With one or two exceptions, pine-distillation products tested are only moderately good solvents. Among many miscellaneous products tested, Aroclor 1242 (a chlorinated diphenyl) is a good solvent. The vegetable oils tested are about as good as the aliphatic petroleum products.

A table is given showing the density, boiling point or range and flash point of some of the solvents that may be most useful, principally in preparing solutions and emulsions for the control of insects affecting man, together with the solubility of DDT in them in pounds per U.S. gallon. They may be useful alone or as auxiliary solvents. They are chosen with regard to various considerations, including availability, cost and possible toxicity to man. Chlorinated solvents, which may be too toxic for use in confined spaces, are included for comparative purposes. The possible usefulness of some of the solvents is briefly discussed.

CAMINHA filho (A.). **A cigarrinha dos canaviais, *Tomaspsis liturata* (Lepeletier et Serville, 1825) var. *ruforivulata* Stål, 1854.** [The Sugar-cane Froghopper.] —19 pp., 5 pls. (3 col.), 8 figs., 11 refs. Rio de Janeiro, Inst. Açúcar Alcool, 1944.

The author describes the habits of Cercopids in general and reviews the species that have been recorded as feeding on sugar-cane in South America. The only one of which the nymphs, like those of *Tomaspsis saccharina*, Dist., in Trinidad, attack the roots of the canes, and which cause any serious injury is *T. liturata* var. *ruforivulata*, Stål, in Brazil. All stages of this froghopper are described, and an account is given of its bionomics and control, based largely on the literature [cf. *R.A.E.*, A **13** 617]. It has been observed not only in the States of Rio de Janeiro and Minas Gerais, but also in Bahia and Sergipe. The chief damage is caused by the feeding of the nymphs; up to 50 have been observed on a single plant. It has been thought that they inject a toxin while feeding. The sugar content of infested canes is much reduced; they are fragile and pale in colour and become susceptible to fungous and bacterial diseases. The adults, which feed on the aerial parts, but cause little injury, avoid direct sunshine. Infestation is slight in low-lying damp fields and high in drier

situations. The pest is thought to be distributed through the transport of infested planting material and possibly also by rivers in flood. Alternative food-plants are grasses, such as *Chloris gayana*, *Cynodon dactylon*, *Pennisetum* sp., and *Paspalum* sp., and natural enemies include various vertebrates, spiders, ants, bugs, and a fungus, possibly *Metarrhizium anisopliae* [cf. 21 520].

The methods of control [cf. 13 617] include rotation of crop with leguminous plants, which are not infested and improve the soil, and planting sugar-cane so as to leave more space between the clumps and give free access to sunlight.

KRAMER (M.), ORLANDO (A.) & SILBERSCHMIDT (K. M.). **Estudos sobre uma grave doença de vírus, responsável pelo deperecimento de nossas culturas de alface.** [Studies on a serious Virus Disease of Lettuce in Brazil.]—*Biológico* 11 no. 5 pp. 121–134, 2 pls., 7 refs. São Paulo, 1945. (With a Summary in English.)

In 1944, lettuces grown near the city of São Paulo were found to be suffering from a virus disease, of which the symptoms are described, resembling the lettuce mosaic found in England and the United States [cf. R.A.E., A 27 671]. Affected plants remained backward in growth, and some failed to produce heads. The disease was said to have been present since 1941, and affected almost all the plants in some market gardens.

Experiments on its transmission were carried out with *Myzus persicae*, Sulz., *Macrosiphum sonchi*, L., and *M. solanifolii*, Ashm., which were observed on lettuce in the field. They were reared on healthy crucifers or cucurbits, which are considered to be immune, kept without food in glass tubes for 3–4½ hours, and then placed on leaves of lettuce showing symptoms of the disease; after feeding for 30 minutes they were isolated in batches of 60 on healthy lettuce seedlings 20–35 days old, having at most 3 or 4 leaves. They did not colonise the healthy plants very readily but survived on them for four or five days. After this period, the plants were removed to insect-proof greenhouses and sprayed with nicotine sulphate to kill any remaining Aphids. Symptoms of the disease were observed a week later, and it was ultimately found that *Myzus persicae* had transmitted it to all the healthy plants on which it fed, *Macrosiphum sonchi* to almost 96 per cent., and *M. solanifolii* to 47 per cent. Out of 177 plants used as controls, only one developed the disease. In a similar test, an unidentified Aphid that occurred near lettuce plantings, but not on the plants, failed to transmit the disease.

*Myzus persicae* was much less abundant on lettuce in the field than were the species of *Macrosiphum*, and a further test was therefore made to discover how many Aphids per plant were necessary for transmission. The results showed that five individuals of *Myzus persicae* or *Macrosiphum sonchi* per plant were sufficient to produce infection in 50–75 per cent. of plants, while the same number of *M. solanifolii* produced it in 25 per cent. In other tests, the disease was transmitted from diseased to healthy lettuce and from lettuce to peas by sap inoculation and it was passed to some extent through the seed of infected lettuce.

The methods of control suggested are the selection of healthy seed, clean cultivation and the prompt destruction of infected plants, and weekly applications of a spray of 0.2 per cent. nicotine sulphate or a dust containing 2 per cent. nicotine against Aphids. The applications should be suspended ten days before cutting, to avoid toxic residues.

ORLANDO (A.) & SILBERSCHMIDT (K.). **O vetor da “clorose infecciosa” das malváceas.** [The Vector of the “Infectious Chlorosis” of Malvaceous Plants.]—*Biológico* 11 no. 5 pp. 138–139, 1 fig. São Paulo, 1945. (With a Summary in English.)

An infectious chlorosis of malvaceous plants, particularly *Sida rhombifolia* and *S. acuta* var. *carpinifolia*, is common in São Paulo, but the vector has not

hitherto been known. In experiments begun in 1943, it was not transmitted by Aphids, Jassids, thrips, an Anthocorid, a Mirid or a mite, but in 1945 unidentified Aleurodids were observed in field cages containing plants of *S. rhombifolia*, among which infection was spreading. On the next day, two large vessels each containing an infected plant of *S. rhombifolia* surrounded by five small healthy plants of the same species, previously fumigated and treated with sulphur, were placed in an insect-proof cage, and adult Aleurodids collected in the field were introduced. Within 3 weeks, four of the ten healthy plants had developed the disease.

COLONIAL OFFICE. **Report and Proceedings of the Cocoa Research Conference . . . May-June, 1945.**—Colonial no. 192, 168 pp., 1 fldg. map. London, H.M.S.O., 1945. Price 3s. net.

The papers presented to this conference include the following :—

NICOL (J.). **The present Position of Research on Capsid Pests of Cacao in West Africa**, pp. 111–113, 4 refs. In this survey of work being carried out at and near Tafo in the Gold Coast on Mirids (Capsids) attacking cacao [cf. *R.A.E.*, A 32 287; 33 65], the author reports that the results of systematic collections begun in the middle of 1944 showed that populations of *Sahlbergella singularis*, Hagl., and *Distantiella theobroma*, Dist., continued to increase after the beginning of the dry season, even when the number of pods had been considerably reduced. A species of *Helopeltis* decreased in abundance as the pods were harvested, but the decline was much less marked in the case of *Bryocoropsis laticollis*, Schum., which was found in numbers on the vegetative parts of the trees. Of 4,547 marked adults of *S. singularis* and 2,049 of *D. theobroma* liberated about 200 yards from the nearest cacao, three and two, respectively, were recovered at maximum distances from the points of liberation of 185 and 320 yards; the latter capture was made 14 days after the last release. Dissections of nymphs of *S. singularis* and *B. laticollis* showed that the percentages parasitised by *Euphorus sahlbergellae*, Wlkn., averaged 10 and 8, respectively, and ranged up to 32 and 16. *E. sahlbergellae* was attacked by the hyperparasite, *Mesochorus melanothorax*, Wlkn., but the proportion affected was generally low [cf. 32 288; 33 195]. A clone developed from a tree found undamaged at Asuansi when every other tree in the plot was badly attacked by *S. singularis* was tested for resistance by allowing caged adults of both *S. singularis* and *D. theobroma* to feed on it for known lengths of time, the resulting damage being compared with that on non-resistant plants. The results were not conclusive, but the clone appeared to be less attractive to *D. theobroma* than to *S. singularis*, and less damaged by either species than the controls. A progeny trial indicated that Mirid resistance may be connected with genetic factors. The normal pathological destruction resulting from a slight attack by *Sahlbergella* cannot be entirely caused by mechanical damage, and is not due to other organic causal agents, and it is concluded that the destruction of the tissues is at least partly due to toxic saliva.

A spray of nicotine sulphate (1 : 1,000) with a wetting agent (Lethalate) has been adopted as a standard test insecticide by the West African Cacao Research Institute [cf. 33 66]. A spray containing 1 per cent. DDT (60 per cent. pure), prepared by dissolving the DDT in a vegetable oil and emulsifying this in water, was found to give a definite residual action, but required considerable quantities of oil. Lower concentrations did not show so much residual effect. *S. singularis* appeared to be much less resistant to DDT than *D. theobroma*, indicating that it might be controlled by a lower concentration; its habit of attacking older trees [cf. 31 418] renders much larger quantities of spray necessary against it.

An entomological out-station is being established at Owena in Nigeria, where cacao has been severely damaged by both *S. singularis* and *D. theobroma*.

POSNETTE (A. F.). **Cacao Virus Research in West Africa**, pp. 114-117. Field surveys have shown that the swollen-shoot disease of cacao has a wider distribution in the Gold Coast and is spreading more rapidly than had been suspected. It has been found in Nigeria, where outbreaks have occurred in the Ibadan district, though the symptoms in some leaf specimens resembled those noticed in Venezuela more closely than those of the Gold Coast viruses. This, together with the recent discovery of cacao viruses in Trinidad, suggests that these may occur wherever the crop has been cultivated on a large scale for 30 years or more. The effectiveness of cutting out infected trees as a means of control was established at Tafo, where monthly inspections followed by prompt removal of infected trees have checked spread from tree to tree and kept the numbers of new outbreaks and of diseased trees fairly constant for three years. Where devastated farms were replanted, the number of seedlings that became infected before coming into bearing was low, and these were usually near old infected trees that had survived. The disease spreads more rapidly in trees that have reached the bearing age, so that, in the absence of control measures, the productive life of the new farms will probably be short. If rogueing can be introduced as a regular practice, it is possible that cacao production could soon become profitable again in the devastated areas, but the presence of a mild strain of the virus in productive trees makes the farmers reluctant to destroy trees in the early stages of infection by a virulent strain. Swollen-shoot disease can be caused by one or other of a complex of viruses. Cross-immunity tests have indicated that two strains (A and B) may be related and that a third (C) may be outside the swollen-shoot complex. Box [who referred to them by numbers] obtained transmission of the first two by *Pseudococcus njalensis*, Laing (*exitiabilis*, Laing) and not by *P. citri*, Risso, which transmitted the third [cf. 34 102], which suggests that though the classification of numerous cacao viruses by the symptoms they produce has limited possibilities it may be simplified by vector investigations.

SQUIRE (F. A.). **Notes on Biological Control**, pp. 117-118. An outline is given of a programme of research on the possibility of finding and introducing parasites for the control of *Sahlbergella singularis*, Hagl., and *Distantiella theobroma*, Dist., in the Gold Coast. It is necessary to make surveys at various places in a great part of West Africa and consider the sub-family BRYOCORINAE as a whole, since some parasites have more than one host. The distribution, ecology and food-plants of the genera resembling *Sahlbergella* are therefore very briefly discussed [cf. 32 287-288; 33 195-196].

YOUNG (A. H.). **Cocoa Storage in Nigeria**, pp. 118-119. The occurrence of insect infestation in stored cacao in Nigeria and methods used for controlling it are briefly reviewed, and a list is given of the precautions required for the protection of cacao stored for the long periods necessary under wartime conditions [cf. 30 212].

THOROLD (C. A.). **Cacao Diseases in Trinidad**, pp. 140-141. Diseases of cacao in Trinidad include a number caused by fungi, of which *Marasmius perniciosus* is the most important, and virus diseases. Transmission experiments have shown that the latter are caused by two strains, designated red mottle virus and vein clearing virus. The symptoms have been found in both weak trees and those that were otherwise normal and vigorous, in a limited area at the western end of the Northern Range in Trinidad. There is no indication of a reduction in yield as a result of virus infection, and the vectors are not known.

PICKLES (A.). **Pest Problems of Cacao Cultivation in Trinidad and Tobago**, pp. 141-143. The more important insects that attack cacao in Trinidad and Tobago include *Selenothrips rubrocinctus*, Giard, which feeds on the foliage, causing staining and russetting of the leaves. Severe infestation usually results in heavy leaf-fall, followed by the production of new foliage and the withering and death of all pods developing at the time. Repeated attacks of this nature

result in severe die-back of the tree, which may be killed in extreme cases. The nymphs are considered to be more injurious than the adults. It is believed that the liability to mass attack by thrips is connected with the physiological condition of the tree, but the connection is obscure. Severe outbreaks can be prevented or controlled by spraying with Bordeaux mixture or milk of lime or by dusting with hydrated lime [cf. 27 24]. The introduced parasite, *Dasy-scapus parvipennis*, Gah., has survived in several localities in Trinidad [cf. 32 80] and extended its range in some of them, but it does not appear to be exerting useful control.

The larvae of *Steirastoma depressum*, L., tunnel in the young branches, especially at the base, or at the collar of the trunk of young trees, causing serious local injury and frequently complete ringing of the affected branch. The adults feed on the bark; this injury is usually superficial, but may be deep enough to cause partial or total ringing. Young trees in vigorous growth and newly trimmed trees are particularly subject to attack. This Lamiid breeds throughout the year, but its numbers increase most rapidly during the dry season. Natural enemies include insectivorous birds, Elaterid larvae and several Braconid parasites, but it is doubtful whether they effect appreciable control.

Attacks by *Howardia biclavis*, Comst., and *Asterolecanium pustulans*, Kll., first recorded in 1941 [30 366] have so far all been confined to young cuttings of selected material. These suffer severe damage when newly planted in the field, and usually die within a few weeks, unless the infestation is promptly checked. A spray of resin wash appears to give reasonably good control. Other Coccids, of occasional and minor importance, include *Pseudococcus citri*, Risso, *Ferrisia virgata*, Kll., *Selenaspilus articulatus*, Morg., and *Aspidiotus destructor*, Sign., some of which may prove to be vectors of the virus diseases.

BUXTON (D. A. J.). **Cocoa Moth** (*Ephestia elutella*), pp. 156-157. A short account is given of the life-history of *Ephestia elutella*, Hb., in stored cacao and of the difficulties of controlling it in London warehouses. Fumigation with hydrocyanic acid gas has given satisfactory results when done in the warehouse, but is unpopular with the trade. Its disadvantages are that cacao to be fumigated cannot be so economically stored, some warehouses are not suitably constructed for fumigation and fumigation in a gas chamber did not seem economically possible. Adhesive bands on the wall or on the floor round the piles have given good results, but it is difficult to get them used properly by the labour employed. Pyrethrum spraying [cf. 27 154] is effective, but is considered only a palliative. Experiments on the impregnation with DDT of the bags used for storing cacao are suggested.

ALIBERT (H.). **Note préliminaire sur une nouvelle maladie du cacaoyer le "Swollen Shoot".**—*Agron. trop.* 1 no. 1-2 pp. 34-43, 4 figs., 1 map, 19 refs. Nogent-sur-Marne, 1946.

The author reviews the results of work in the Gold Coast on the separation of the viruses that cause swollen-shoot disease of cacao, the vectors of various strains and cross-immunity tests [cf. R.A.E., A 34 102; 35 88]. A survey of neighbouring French territory in 1943-45 showed that the disease was present in four administrative districts of the Ivory Coast, but not in French Togoland. Its distribution in the Ivory Coast and the Gold Coast is shown on a map. Experiments in the Ivory Coast confirmed that its spread can be arrested by the destruction of infected trees [cf. 32 26; 35 88], and an attempt is to be made to obtain strains of cacao that are resistant to it. A method of detecting the presence of the virus before the appearance of symptoms, by means of a coloration test, is briefly described.

URQUHART (D. H.). **Report on the Department of Agriculture (Gold Coast) for the year 1944-45.**—8 pp. Accra, 1945.

This report on work in the Gold Coast in 1944-45 contains a section on cacao (pp. 3-5) in which the results are given of a survey of the prevalence of swollen-shoot disease in the greater part of the colony [*cf. R.A.E.*, A **35** 88] and reference is made to its recent discovery in Nigeria [*cf. loc. cit.*] and the Ivory Coast [*cf. preceding abstract*]. Experiments at Tafo have indicated that its spread can be stopped by the prompt removal of infected trees, without destroying adjacent healthy ones [*cf. 32* 26; **35** 88].

In the section dealing with entomology (p. 8), it is reported that swarms of *Schistocerca gregaria*, Forsk.] that invaded Ashanti and the Northern Territories in February and March 1944 left in a north-easterly direction without ovipositing, the last being reported in April. Attacks were observed on cassava [*Manihot utilissima*], cotton, yams [*Dioscorea*], ground-nuts [*Arachis hypogea*], and vegetable crops and on various trees, but were not heavy. The weevil, *Pachymerus lacerdae*, Chev. [*cf. 33* 165], was found locally in nuts of oil palm [*Elaeis guineensis*] with rotting pericarps attached, on trees that were not regularly harvested. It was not observed on dried nuts in storage.

GARDNER (J. C. M.). **A Note on the Insect Borers of Bamboos and their Control.**—*Indian For. Bull.* no. 125 [3+] 17 pp., 3 pls., 2 figs. Dehra Dun, 1945.

Felled bamboo culms in northern India are attacked by numerous insect borers. The most important are the Bostrychids, *Dinoderus minutus*, F., *D. brevis*, Horn, *D. ocellaris*, Steph., *Bostrychopsis bengalensis*, Lesne, *B. parallela*, Lesne, and *Heterobostrychus aequalis*, Waterh. [*cf. R.A.E.*, A **24** 97; **33** 71], of which the species of *Dinoderus* are particularly injurious, and Lyctids [**33** 71]. Parasites, especially *Sbeilla furax*, Wlkn. [**22** 311] and *Spathius* spp., cause considerable mortality among the immature stages, but do not afford reliable control. The Cerambycids, *Chlorophorus annularis*, F., and *Stromatiron barbatum*, F., are fairly common, but cause little injury at Dehra Dun. Their life-cycle normally lasts one year, but may require two or more, and, unlike the Bostrychids and Lyctids, they can develop in culms that have been immersed in water for long periods; impregnating the culms with preservatives prevents attack and coating them with creosote and oil gives temporary protection. Carpenter bees [*Xylocopa*] cause some damage in hollow bamboo that has not been treated with creosote [*cf. 27* 337], and several Anthribids have been reared from bamboo, though attack by them is probably secondary. Larvae of the Hispid, *Estigmene chinensis*, Hope, bore in living culms [**33** 389], but, unless infestation is heavy, do not render them unusable for scaffolding and ladders.

The larvae of the Bostrychids, like those of Lyctids, cannot develop in starch-free tissue; they were also unable to develop in bamboo that retained a high starch content after prolonged immersion in water, probably owing to the removal of other essential substances [*cf. 24* 551]. At Dehra Dun, the starch content of living culms is highest in May-June, decreases gradually in July-August, after the rains begin, and rapidly after September, reaches a minimum in November-December, and then rises again. Borer attack appears to be closely correlated with the starch content until May, after which it is lower than would be expected, evidently owing to the natural depletion of starch in the felled culms. This was complete in three weeks during the rains and slowest in April-June. Infestation is light in culms felled during July-January and severe in those felled between March and the beginning of the monsoon. Bamboos flower gregariously after long intervals, and the clumps then die.

Observations at Dehra Dun on an isolated clump of *Dendrocalamus hamiltonii* that flowered in March 1944 showed that flowering and seed maturation caused complete starch depletion and that culms cut after the seed had ripened (about three months after flowering began) were not attacked by Bostrychids or Lyctids; infestation by *Dinoderus* became severe in culms cut only four weeks after flowering. These observations were confirmed by others on *Dendrocalamus strictus*. Culms of this species in Hyderabad that were felled four years after flowering were not attacked by borers, were darker in colour and lighter in weight than culms from living clumps and were superior in paper-making qualities; the strength and specific gravity of culms of *D. hamiltonii* felled after seed maturation were about 75 per cent. as great as those of fresh culms.

In experiments on the effectiveness of immersion in water, culms of *D. strictus*, *D. hamiltonii*, *Bambusa tulda* and *B. nutans*, all with a high starch content, were immersed for 4–12 weeks and then exposed to attack by borers. Immersion for 12 weeks destroyed any insects present and afforded considerable protection from *Dinoderus*; immersion for 10, 8 and 6 weeks gave progressively less protection, and immersion for 4 weeks none. The starch content was not apparently altered by the immersion, which only removed soluble sugars, and light infestations of *Lyctus* developed in nearly all the tests, even after immersion for 12 weeks. *Chlorophorus annularis* occurred only in *D. hamiltonii* and only when the period of immersion did not exceed 10 weeks. *B. tulda* immersed in artificial sea-water for 6 weeks or more was not attacked by *Dinoderus*, and infestation after 4 weeks' immersion was moderate. Baking bamboo culms prevented infestation by Bostrychids if the moisture content was reduced to below 5 per cent., but not otherwise; in damp localities, sufficient moisture to enable development to proceed might be re-absorbed from the atmosphere.

Soaking culms in aqueous solutions of inorganic salts was ineffective owing to insufficient absorption, and treatment under pressure caused hollow culms to burst. When freshly-felled culms with the leaves intact were placed upright with the lower ends in aqueous solutions of inorganic salts or in creosote, the former penetrated in considerable amounts to great heights, but the latter not at all. When the basal internode of an inverted culm was filled with an aqueous solution, the latter passed down the culm provided that it was moist and that the longitudinal vessels of the basal internode had been exposed to the solution by making an incision round the interior of the wall; the solutions passed through readily when the upper end of the culm was connected by a rubber tube to a reservoir. When creosote was used in inverted culms, it penetrated through a length of 15 ft. in an average of 24 hours if the culms were dry and 45 hours if they were moist; 2–4 cc. creosote was absorbed per linear ft., and bamboo treated in this manner was not attacked until it was split, after which it became infested in a few months. The addition of fuel oil or rape oil to the creosote delayed penetration and reduced the amount of creosote absorbed, and the addition of kerosene reduced vertical penetration by causing lateral spread, as a result of which the basal parts became saturated. Culms felled in April–May 1942, swabbed with a mixture of creosote and fuel or rape oil (1 : 4) and exposed to attack were intact a year later except for a few in which the extremities were damaged, whereas infestation in the controls was severe. Some of the culms were then split, and these had all been attacked after a further year; some entire treated culms were also attacked after this period. The effectiveness of impregnating culms with creosote after drilling holes in each septum throughout their length to prevent bursting during treatment under pressure was tested on culms of *B. balcooa* 14 ft. long. When drilled culms that had been immersed for two hours in creosote heated to 95°C. [203°F.] and had absorbed 1.6 lb. creosote per cu. ft. were examined after two years, they still contained a high proportion of starch, there were a few exit holes of *Dinoderus* in most internodes and living larvae were present. Other drilled culms that were immersed in the

hot creosote in an open tank for six hours and allowed to cool in the oil for 16 hours, or were subjected to pressure treatments in which the maximum pressure was 150 lb. per sq. in. for one hour, absorbed over 4 lb. per cu. ft. and were completely protected. The controls, which had evidently been subjected to a baking process, were severely attacked.

In large-scale trials of a method subsequently adopted as a standard treatment, the materials under test were injected into each internode through a hole drilled near the septum and the holes were plugged with putty. The culms were rolled to ensure coating of the inner walls and stacked vertically, with the holes uppermost, after the open ends had been swabbed with preservative. Culms of *B. nutans*, *B. tulda*, *Dendrocalamus strictus* and *D. hamiltonii* that were felled in April–May and had a high starch content were used, and liquids were injected at a dosage of 20 cc. for internodes with a capacity of up to about 40 cu. ins. and 30 cc. for those of about 50 cu. ins. The periods required for absorption ranged from two days when the preservative was mixed with kerosene to over two years when it was mixed with a heavy oil (Attock oil). The treated culms were stored with heavily infested untreated material, and some were split from time to time. Examination 2½ years later showed that mixtures of creosote and fuel oil (1 : 1) or rape oil (1 : 4) had completely protected entire culms and prevented cracking; split culms were lightly attacked after one year. Mixtures of creosote and kerosene (1 : 4) and of creosote, kerosene and Attock oil (1 : 1 : 3) protected entire culms, but not split ones, and culms treated with the latter tended to crack. Naphthalene as a powder injected at a rate of 4 gm. per internode or incorporated in kerosene, or a mixture of kerosene and Attock oil (1 : 1) at 20 gm. per 100 cc. was satisfactory for entire culms but less effective after the culms were split. Rape oil alone afforded some protection, but emulsions of rape oil or kerosene with soap and boric acid or copper sulphate, and aqueous solutions of boric acid, zinc chloride or copper sulphate did not prevent attack. It is concluded that the best material is creosote with fuel oil or with rape oil. Treatment should be carried out shortly after felling, and though primarily designed to prevent attack, it will eliminate infestations in the early stages and give high, though not complete, mortality of insects present in severely infested bamboo.

FENNAH (R. G.). **Preliminary Tests with DDT against Insect Pests of Food Crops in the Lesser Antilles.**—*Trop. Agriculture* **22** no. 12 pp. 222–226. Trinidad, 1945.

Tests of DDT against local pests of vegetable and staple food crops, and also against some that affect man and animals [cf. *R.A.E.*, B **35** 36], were carried out in St. Lucia in 1944 and early 1945. A stock emulsion containing 40 gm. DDT per 70 ml. tetralin [tetrahydronaphthalene], 10 ml. Triton B-1956 [a phthalic glyceryl alkylid resin], 1 gm. soap and 145 ml. water, diluted with soft water to the required concentration, was used for all spray tests. A spray containing 3 per cent. DDT tested against *Toxoptera aurantii*, Boy., on *Citrus* and against *Paratrechina (Prenolepis) longicornis*, Latr., killed all the ants and Aphids that it wetted completely. The Aphids that were incompletely wetted ceased to feed, wandered and eventually fell to the ground; such fallen individuals all died within nine hours when transferred to a moist cage, whereas unsprayed Aphids showed less than 1 per cent. mortality in the same period. A spray containing 5 per cent. DDT applied against nearly full-fed larvae of *Pseudosphinx tetrio*, L., on frangipani [*Plumeria*] caused them to wander and fall to the ground. They recovered muscular activity after the spray had dried on the cuticle, but did not resume feeding, and a second complete wetting within two hours of the first caused immobilisation and death without further activity.

In laboratory tests of the spray residue, examples of 40 well-known pests belonging to five Orders were taken in the field and transferred to cages, the floors of which were completely covered with leaves of their normal food-plants. The leaves in one set of cages had been sprayed some hours previously and bore a deposit of 1 mg. DDT per sq. in. The temperature was 72–83°F. and the relative humidity 85–98 per cent. Complete mortality of the adults of the two species of Diptera was obtained after 24 hours' exposure to the deposit, of the 13 species of Lepidopterous larvae after 36 or 48 hours, and of the three species of Orthoptera after 48 hours. Complete or almost complete mortality of the 13 species of Hemiptera was obtained in 36 or 48 hours, and adults of most of the nine species of Coleoptera were all dead within the same periods. In practice, the distribution of DDT over a plant in the field may be uneven, but in field trials still in progress when this paper was written, a spray applied so as to give a deposit of 1 mg. DDT per sq. in. gave results against *Nezara viridula*, L., *Ascia monuste*, L., *Plutella maculipennis*, Curt., and *Anticarsia* (*Thermesia*) *gemmatalis*, Hb., that accorded well with those obtained in the cage tests.

The effect of rainfall on the deposit was investigated by spraying microscope slides and exposing them to rain. The initial deposit consisted of crystalline aggregates, ranging from 27 to 84  $\mu$  in diameter, of a frequency of 38 per sq. mm. Samples taken at intervals of 15, 30 and 60 minutes and two days (the last representing 1.6 inches of intermittent rain) showed a progressive erosion of the aggregates. In a deposit eroded soon after application, the crystals were small and acicular, indicating that some of the DDT had been washed away before it had crystallised out of solution. The removal of dry deposits of crystals appeared to be due to the mechanical action of rain-drops as they impinged on the slides, since the careful addition of a drop of rain-water to the sprayed surface of a slide caused no apparent loosening or removal of DDT crystals. The degree of erosion from the exceptionally smooth surface used was probably maximal, but suggests that moderately heavy showers may seriously reduce a deposit of DDT on the upper surfaces of leaves. The largest crystal aggregates were found to be relatively durable, so that the comparatively large droplets delivered by a knapsack sprayer may prove advantageous under the local wet-season conditions.

A 10 per cent. DDT powder and sprays containing up to 5 per cent. DDT did not injure the leaves of leguminous plants, cucurbits, cabbage, sweet potato, tomato or egg-plant [*Solanum melongena*], though the leaves of egg-plant were scorched when the stock emulsion was diluted with hard water. The risk of destroying insect parasites and predators by applying DDT to food crops in West Indian islands is considered negligible in view of the wide range of alternative food-plants and breeding-grounds of the major pests. Injury to pollinating insects can be avoided by discontinuing applications between flowering and fruit-setting. Sprays directed against pests that feed on the lower surface of the leaves, should be applied to that surface only.

A colony of wild bees was eradicated from the roof of a house by spraying their entrance hole and the surrounding wood-work with 3 per cent. DDT [cf. R.A.E., A 35 55], and the same spray applied to the lower surface of the leaves to give about 120 mg. DDT per sq. ft. killed almost immediately a large population of Tetranychid mites on *Cassava*, and checked a similar outbreak on *Setaria*.

No ill effects of any kind were noticed when the author inhaled 100 mg. of sifted pure DDT daily for 13 months, with a break of a fortnight, and drank water dusted with pure DDT at more than 300 mg. per sq. ft. daily for the same period with a break of a month, or later when all the food he took over a period of a month was sprayed, following preparation, with 3 per cent. DDT to give a deposit of 100 mg. per sq. ft., or when his arms and hands were swabbed at

intervals of about 15 days with 5 per cent. DDT emulsion, which was allowed to dry to give a deposit of 200 mg. per sq. ft.

RICHEY (F. D.). **Maize Hybrids susceptible to Earworm. Heritable Differences in Susceptibility of Corn Hybrids to early Attack.**—*J. Hered.* **35** no. 11 pp. 327–328, 1 fig. Washington, D.C., 1944.

Single-cross hybrids of two inbred strains of maize in experimental plots in Tennessee in June 1944 showed a high susceptibility to infestation by the corn ear-worm [*Heliothis armigera*, Hb.] and damage to the leaves was severe. Injury on hybrids of either strain with two others that were tested was not so severe but was greater than the average for other single-crosses and varieties.

BENNETT (S. H.) & KEARNS (H. G. H.). **An Experiment on the Control of Pear Midge (*Contarinia pyrivora*).**—*J. Pomol.* **22** no. 1–2 pp. 38–40, 4 refs. London, 1946.

The authors briefly review the bionomics of *Contarinia pyrivora*, Ril., a local pest of pear in England, and measures tested for its control [cf. *R.A.E.*, A **18** 597]. It has been observed in commercial practice that calcium cyanide worked into the soil beneath infested trees gives very variable results and often fails on heavy soils. Staniland & Walton found that a spray of nicotine applied to the open blossom gave a marked reduction in infestation, but more consistent results were obtained by the present authors with a heavy application of a nicotine spray at the early white-bud stage, when the adult Cecidomyiids were abundant on or about the trees. Since a reduction of infestation was observed in 1943 on trees sprayed with dinitro-o-cresol and petroleum oil just before bud burst, tests were carried out in Gloucestershire in 1944 on the value of soil treatments with a spray containing 3 per cent. high-boiling, neutral tar oil and one containing 0.1 per cent. dinitro-o-cresol with 5 per cent. petroleum oil (Grade E), both emulsified with sulphite lye [cf. **30** 106] and applied to the soil in a pear orchard at the rate of 900–1,200 gals. per acre. Applications were made either at bud burst or immediately before the white-bud stage (1st and 27th March, respectively). All treatments gave a high degree of control; the percentages of fruitlets infested on comparable trees were 5 and 7 for the early and late application of tar oil, 9 and 10 for those of dinitro-o-cresol, and 64 for no treatment. The differences between treatments were not significant. The increase in numbers of harvested fruits ranged from 46 to 100 per cent.; this resulted in smaller pears, but the increases in weight ranged from 31 to 53 per cent. General observations suggested that if the trees are well grown and give promise of bearing a heavy crop of blossom, they may be able to withstand up to 75–80 per cent. infestation of blossoms without serious loss in weight of crop.

MOORE (M. H.). **Improving the Field Performance of standard protective Fungicides. I. The Place of Spreaders in the Spray Programme for Apple Trees.**—*J. Pomol.* **22** no. 1–2 pp. 76–91, 24 refs. London, 1946.

Until 1932, when the experiments here described were begun, apple trees in England normally received separate applications of contact insecticides and fungicides. Contact insecticides were applied in the form of a drenching spray, together with a good spreader, such as soft soap, which allowed the liquid to flow over the tree and thoroughly wet the insects, while protective fungicides

were applied at fairly high concentrations as soft, misty sprays. Since the application of numerous separate sprays is uneconomic, a means was sought of incorporating the fungicide and insecticide in the same spray, without damaging the trees by the necessarily heavier deposit of fungicide. In the experiments described, which were carried out at East Malling between 1932 and 1944, an investigation was made of the damage caused by combined fungicidal and insecticidal sprays, used alone or with spreading agents, and of their effectiveness against apple scab [*Venturia inaequalis*] and the apple sawfly [*Hoplocampa testudinea*, Klug].

In the tests in 1932-34, lime-sulphur was applied to apples of four varieties at 3.3 per cent. at the pink-bud stage and 1 per cent. at the petal-fall and fruitlet stages as a soft, misty spray, without a spreader or with 0.1 per cent. gelatin (then favoured as a spreader and adhesive), or as a drenching spray with gelatin, and at 2.5 per cent. pre-blossom and 0.75 per cent. post-blossom in a drenching spray with 0.75 per cent. sulphite lye or 0.1 per cent. Sulphonated Lorol (sodium salts of mixed primary alcohol sulphates) as spreaders. The sprays were applied at a pressure of about 200 lb. per sq. in., and nicotine (0.05 per cent.) was included in all treatments when necessary against the sawfly, Aphids and small caterpillars. In some plots, 0.5 per cent. colloidal sulphur replaced the lime-sulphur in post-blossom applications, enabling soap-solution to be tested as a spreader. Comparison of the results showed that heavy (drenching) applications of lime-sulphur caused more spray damage than light, and fruit drop on Allington Pippins was greater with the stronger than with the more diluted spray. Marginal leaf-scorch was decreased when both the dilution and spreading capacity of the spray were increased. Newton Wonder suffered severe fruit drop following heavy applications, but these gave better control of both scab and sawfly than light ones. Nicotine and weak lime-sulphur with a spreader, heavily applied, proved superior to nicotine and full-strength lime-sulphur without a spreader, lightly applied, especially against scab, where infection occurred before the first application. A spreader was advantageous to nicotine and colloidal sulphur heavily applied. The spreaders differed little in general effect, except that gelatin appeared to reduce the fungicidal efficiency of lime-sulphur, and soap solution with colloidal sulphur caused fruit-drop on Worcester Pearmain and Newton Wonder.

In 1935 and 1936, lime-sulphur, with 0.05 per cent. nicotine, was applied heavily at 2.5 per cent. pre-blossom and 1 per cent. post-blossom, the pressure was increased to 300 lb. per sq. in. and seven spreaders were tested. The results in 1936 confirmed the intolerance of Newton Wonder, and, to a less degree, of Allington Pippin, towards lime-sulphur heavily applied. All treatments gave very high control of both scab and sawfly, and the spreaders conferred no advantage. The use of an adequate volume of spray at an adequate pressure appeared to be of greater importance than the presence of spreaders, which differed little in their effect [*cf.* R.A.E., A 23 629] except that 0.1 per cent. Ester Salts (sodium salts of mixed secondary alcohol sulphates) and 0.75 per cent. of a 20 per cent. solution of sodium  $\beta$ -sulphonates increased spray damage.

In 1937, lime-sulphur was applied heavily to Cox's Orange Pippins at a pressure of 300-350 lb. per sq. in., with and without a spreader, but the concentration was 1 per cent. in pre-blossom as well as in post-blossom sprays, in order to permit scab to develop to some extent. Applications were made at the green-cluster, pink-bud, petal-fall and fruitlet stages, and 0.4 per cent. lead arsenate paste was added to the pre-blossom sprays on all trees against caterpillars, and 0.05 per cent. nicotine to the petal-fall spray against the sawfly. The results showed that the presence of the spreader decreased scab control but protected the trees from fruit-drop, defoliation and leaf-scorch caused by lime-sulphur

or soluble arsenic. This was due to increased run-off, which led to lighter deposits. It has since been found that the amount of soluble arsenic in such sprays increases as the proportion of lime-sulphur to lead arsenate decreases [cf. 29 281].

In 1944, a preparation of 40 per cent. colloidal sulphur with or without a spreader was applied heavily at 0.8 per cent. at the green-cluster and pink-bud stages and at 0.6 per cent. at petal-fall, with the addition of 0.2 per cent. lead-arsenate powder at green cluster and 0.05 per cent. nicotine at petal-fall. The spreader slightly improved the high scab control given by the sulphur, and no spray injury was observed.

In 1937, weak Bordeaux mixture (2 : 3 : 100) with and without a spreader was applied to Cox's Orange Pippins at a pressure of 300 lb. per sq. in. at the petal-fall and fruitlet stages, with the addition of nicotine at petal-fall, following 2 per cent. lime-sulphur and 0.4 per cent. lead arsenate paste at the green cluster and pink-bud stages. Scab was almost completely controlled by the lime-sulphur, but the Bordeaux mixture caused some leaf-scorch, defoliation, fruit russetting and loss of crop, and the damage was increased by the use of a spreader.

Reviewing the results of the work, the author concludes that there is no disadvantage in combining fungicides and contact insecticides in the same spray. For sawfly control, a spreader may be necessary with nicotine and colloidal sulphur heavily applied at low pressure at petal-fall, but not with nicotine and lime sulphur heavily applied at high pressure [cf. 23 429]. The difference is probably attributable to the fact that lime-sulphur itself exerts some control of the sawfly [cf. 22 52].

#### PAPERS NOTICED BY TITLE ONLY.

GÓMEZ-MENOR (J.). **Contribución al conocimiento de los Aleyródidos de España (Hem. Homop.). Variabilidad en las especies españolas y descripción de dos nuevas. 2a nota.** [Contribution to the Study of Aleurodids in Spain (Hem. Homop.). Variability of the Spanish Species and Description of two new Species (including *Bemisia citricola* on *Citrus*, etc.). Second Note.]—*Eos* 20 pt. 3-4 pp. 277-308, 4 pls., 3 figs., 15 refs. Madrid, 1945.

SUBRAMANYAM (T. V.). **Control of the Sugarcane Borers** [*Proceras sticticraspis*, Hmps. and *P. venosatus*, Wlk.] **by the Egg Parasite** *Trichogramma minutum* **R. in Mysore.**—*J. Mysore agric. exp. Un.* 19 no. 4 pp. 183-187. Bangalore, 1941. [Cf. *R.A.E.*, A 34 207.]

GERSDORFF (W. A.) & MCGOVAN (E. R.). **Insecticide Toxicity Studies. Experimental Results on the comparative Toxicity** [to *Musca domestica*, L.] **of Benzene Hexachloride, DDT and Pyrethrum.**—*Soap & sanit. Chem.* 21 no. 11 pp. 117, 121, 1 fig., 1 ref. New York, N.Y., 1945. [See *R.A.E.*, B 35 38.]

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